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A Record of the Progress of Pharmacy and the Allied Sciences

COMMITTEE ON PUBLICATION.

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NOTICE OF COLLEGE MEETING: The stated quarterly meeting of the members of the Philadelphia College of Pharmacy and Science will be held in the College Building, 145 N. Tenth Street, on Monday, December 31, 1923, at 2.30 P. M. General business. No additional notice of this meeting will be sent out. Members are therefore requested to make note of the date.

AMBROSE HUNSBERGER, Recording Secretary.

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EDITORIAL

POPULAR SCIENCE.

Two words that have kept apart for many a generation are now so commonly come together in the public eye. Yet even today we find a few of the old breed of scientists who fail to see a thing but crass attempts at vulgar show in this endeavor to bring the thoughts of "pure scientists" into a phraseology that "fitteth all understanding." Certainly there are those who know the sting of being held to public stare, misrepresented and ridiculed by jaundiced periodicals, who have drawn back into their shells and refuse for evermore to suffer their "pure" science to beholden to the vulgar tricks of hoax-hucksters and Barnum-brokers. For them there is sympathy and some justification. Then there are those who are of nature retired and who are utterly at a loss to translate themselves to words of simple design.

But the day has nevertheless come when the secret press of science must yield its story to the public mind. No longer shall scientists write only for scientists, in a language which so far as the average person is concerned might just as well be Scandinavian. For the demand of the day is for popular education—and the pure sciences, whether Comparative Psychology or Morphology or Immunology or Experimental Zoölogy or any other -ology—all must bring their wares to the public table and all must have them fit for smooth assimilation.

In a recent newspaper article by Henry Hyde we read that a few years ago scientists and research workers were not willing to take the slightest pains to make the results of their labors intelligible to the general public. They were interested, as Charles W. Eliot, then president of Harvard, wrote, only in the opinions of their fellow-workers in the scientific field. They were "pure scientists," and

proud of it. Especially were they scornful of the newspapers and popular magazines.

More recently, if only as a matter of self-protection, their attitude has somewhat changed. In Germany, for instance, research workers have discovered since the armistice that, largely because of their own aloof attitude, they are popularly looked upon as harmless and more or less useless "high-brows," who in times of emergency can be safely neglected. As a consequence of that attitude Europe is today full of research workers and scientists who are practically penniless and almost entirely neglected in favor of more "practical" men.

That industry, manufacturing, medicine, health and public safety largely depend for their advances on the work of research laboratories has not been and is not today being generally recognized.

And, continues the writer, the scientist is fast coming to realize that his duty to himself and to his work requires that so far as possible the results of scientific research be made plain to the public. All he asks is that it be not misrepresented or turned into an unjustified sensation.

Indeed the field of journalism today offers only a limited scope to the quack and the hoaxer. There is a healthy curb to their itch for notoriety. Of course there is a class of scurrying readers that need the intermittent thrill of cheap sensation. But the great majority of lay readers of today are searching for better reading matter, they are avid for simplified science. They shall have it; and in granting it to them—in coming down from the "high-brow stuff"—Science and scientists are not demeaned—indeed, in serving the times they are themselves being served and their progress made infinitely more certain.

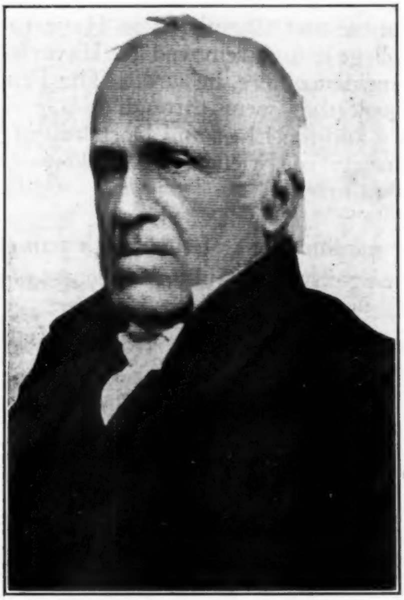
IVOR GRIFFITH.

ON THE ADDRESS OF DANIEL B. SMITH,

First President of Philadelphia College of Pharmacy.

Elsewhere in this issue is reprinted the Commencement Day address of the first President of the Philadelphia College of Pharmacy, delivered before the Graduating Class in September, 1829. We heartily commend it to the attention of our readers. We hope that it will be carefully read. So deftly fashioned is the message recorded in its well-selected words that it fits into this day and generation quite as

neatly as it did a hundred years ago. And there is balm in every paragraph to those among us who would search for marks of service rendered by their predecessors. There is written evidence of the vision of those sturdy Quaker men whose keen foresight often draws the questionable compliment that they "builded better than they knew." What has Pharmacy ever done for America? Read Daniel Smith's address—it answers the question fully. And in reading his address picture the orator as a simple mannered, dignified Quaker gentleman, whose work was so magnificently done—for the old college and for American Pharmacy in general.



DANIEL B. SMITH.

A former writer to this Journal stated that:

"No history of American pharmacy would be complete without due reference and credit being given to this most learned and public-spirited pharmacist of his day for the versatility of his attainments. While characterized by a quiet and unostentatious manner, he was, nevertheless, a happy combination of business man, philanthropist, literary and scientific scholar, teacher, author and editor. In all of these activities he established an enviable reputation, and won the admiration of his contemporaries.

He took an active interest in the notable discoveries in physics and chemistry, and repeated many of the published experiments. He became a member of the Franklin Institute soon after its organization in 1824. He was elected a member of the American Philosophical Society in 1829, and was also a member of the Academy of Natural Science. He was one of the inaugurators of the Historical Society of Pennsylvania, and that society's first Corresponding Secretary. He was one of the incorporators of the Philadelphia Savings Fund, and also of the institution known as the House of Refuge.

"While science and philanthropy claimed much of his time, achievements in the field of general literature were equally attractive. In 1834 he accepted the chair of Moral Philosophy, English Literature and Chemistry in Haverford School (now Haverford College), and removed to Haverford. During his twelve years' residence here, he wrote 'The Principles of Chemistry,' a textbook that went through two revisions. His lectures on 'Ethics and the Lives and Doctrines of the Early Members of the Society of Friends' are spoken of as literary productions of great merit."

Such were the qualifications of this gentleman of science, whose eloquent address we again respectfully commend to our readers' careful attention.

IVOR GRIFFITH.

ORIGINAL ARTICLES

THE CHEMICAL EXAMINATION OF SOME COMMERCIAL BRANDS OF CARBON TETRACHLORIDE.

By L. E. Warren.

The use of carbon tetrachloride for the treatment of hookworm disease was first suggested by Maurice C. Hall,[1] of the Bureau of Animal Industry of the United States Department of Agriculture. For a number of years chloroform had been used as an anthelmintic against hookworms[2] and Hall was led to employ carbon tetrachloride in experiments upon animals infected with

[1] Hall, Maurice C.: *Jour. Agr. Res.*, *21*, 157 (1921); *Ibid.*, *23*, 163 (1923).
Hall, Maurice C.: *Jour. Am. Med. Assoc.*, *77*, 1641 (1921).
Hall, Maurice C.: *Am. Jour. Trop. Med.*, *2*, 373 (1922).
[2] Schultz, W. H.: *Jour. Am. Med. Assoc.*, *57*, 1102 (1911).

hookworms because of its chemical relationship to chloroform, its higher boiling point and its scantier solubility in water. He gave the substance to dogs infected with hookworms and found that they tolerated the drug well, that toxic symptoms did not appear and that all of the hookworms present were removed, a result which he had never been able to accomplish by a single dose of any other anthelmintic. Hall also administered carbon tetrachloride to horses and swine and found that it was very effective against the blood sucking strongyles and moderately effective against ascarids. Experiments were also carried out on many other animals. In order to test its toxicity on man Hall swallowed 3 cc. of the drug and experienced no symptoms except an eructation of carbon tetrachloride and a slight sensation of warmth in the stomach which soon passed away. Because of the possibility of impurities Hall cautions that only a pure and carefully refined drug should be used. In collaboration with Hall, Lake[3] and Schillinger administered carbon tetrachloride to monkeys. In general the results indicated that these animals may be given large and repeated doses of the drug without showing evidence of injury or lesions due to the drug on postmortem examination. In other words the drug was practically non-toxic in doses that were effective as a vermifuge. As a result of these experiments Hall concluded that carbon tetrachloride was more effective in removng hookworms from animals than any of the other drugs commonly employed and that it was not only safe but much cheaper than other anthelmintics. Suggestions for its use in the treatment of hookworm disease in man naturally followed.

Apparently the first account of the use of carbon tetrachloride in the treatment of hookworm disease in human beings was contained in a dispatch to the *London Times*[4] from the Fiji Islands in which the statement was made that in experiments upon coolies, 98 per cent. of the hookworms present were removed by a single dose of the substance. This work was afterward fully reported by Lambert.[5]

Encouraged by Hall's findings Leach[6] administered carbon tetrachloride to fourteen volunteer prisoners, all but one of which were known to be infested with hookworms. Three weeks later all

[3] Lake, G. C.: *Public Health Rep.*, *37*, 1123 (1922).
[4] Dispatch, *London Times*, Feb. 11, p. 9 (1922).
[5] Lambert, S. M.: *Jour. Am. Med. Assoc.*, *79*, 2055 (1922).
[6] Leach, C. N.: *Jour. Am. Med. Assoc.*, *78*, 1789 (1922).

were negative to hookworm ova. To a condemned prisoner a dose of 10 cc. was administered, followed in a week by 2 cc. more. At necropsy, twenty-two days after the last treatment no hookworms were found but an enormous number (3429) of oxyurids and thirty-two trichurids were found. The spleen was normal in size and consistency, the liver showed no lesions on microscopic examination, and the kidneys were normal in appearance.

Acting on Hall's suggestion Nicholls and Hampton[7] administered carbon tetrachloride to ninety-nine persons (mostly children) most of whom were infected with hookworm and many with other helminths. These workers found the drug efficient for the removal of hookworm but not as effective as oil of chenopodium for the removal of ascaris.

McVail[8] reported on the use of carbon tetrachloride in the treatment of hookworm disease in India. He and his assistants employed the drug alone and in admixture with castor oil and with oil of chenopodium. In sixty minim doses alone it appeared to be soporific but was without other untoward effects except in one very old man in which irregularity of the pulse and slurring speech were observed. When used alone the drug was completely effective in forty-one out of fifty-one cases. The drug was effective in removing hookworms and threadworms but was not of much value against ascaris, trichuris and hymenolepsis. Because of the possibility that the drug might cause acute yellow atrophy of the liver McVail cautions against its employment as a routine, standard treatment until its limitations have been determined.

Lambert[9] administered carbon tetrachlorile to 20,000 patients in the Fiji Islands without a single death. He reported that the drug is a vermifuge and vermicide of great potency, that it gave but little discomfort, and that, because of its cheapness, it would permit the treatment at low cost of vast populations who were suffering from hookworm disease. From the standpoint of safety, efficiency and economy Lambert considered the remedy superior to chloroform, thymol or oil of chenopodium. It was not as effective as oil of chenopodium in removing ascarids or whip worms but it removed threadworms in large numbers.

[7] Nicholls, L., and Hampton, G. G.: *Brit. Med. Jour.*, II, 8 (1922).
[8] McVail, J. B.: *Ind. Med. Gaz.*, *57*, 290 (1922).

In a later paper [9] Lambert reported treatment of an additional 30,000 cases but with three deaths and five other cases of serious illness. The first 42,000 cases were treated by Lambert with a certain lot of "carbon tetrachloride which showed on analysis a small amount of carbon disulphide insufficient to do harm." No deaths or notable untoward symptoms were produced. The next 8000 cases were treated by a different supply of carbon tetrachloride. The three deaths and the cases of illness occurred in this group. The drug was examined and found to contain a considerable quantity of an unidentified impurity. At necropsy the liver in one case showed severe necrosis of the central and intermediate zones of the lobules. Many small, petechial hemorrhages were found under the capsule of the liver. Lambert believes that pure carbon tetrachloride would not be toxic. In the latest work Lambert has given the carbon tetrachloride mixed with a concentrated solution of magnesium sulphate. The results were better than when the purge was given three hours after the administration of the drug.

After learning of Hall's work Smillie and Pessôa [10] in São Paulo found, that by giving a dose of 3 cc. of carbon tetrachloride divided into three hourly doses of 1 cc. each, 98 per cent. of the hookworms were removed by one treatment. Smaller doses were less effective. The male hookworms were more resistant to the treatment than the females. This differs from oil of chenopodium which has a greater toxicity to the male hookworm.[11] Smillie and Pessôa observed toxic effects in both dogs and man, the lesions being similar to those produced by chloroform. The symptoms were much worse in persons who were partially intoxicated with alcohol at the time of treatment. These workers conclude that carbon tetrachloride in maximum doses of 3 cc. is a reasonably safe treatment for hookworm disease.

Meyer and Pessôa [12] have studied the toxicity of carbon tetrachloride on dogs. They found that the substance produced lesions in the liver and to a lesser extent in the kidneys. They found it to be a powerful vermifuge, but warned that it should be given with caution to human beings.

[9] Lambert, S. M.: *Jour. Am. Med. Assoc.*, *80*, 526 (1923); *Ibid.*, *81*, 1553 (1923).

[10] Smillie, W. G., and Pessôa, S. B.: *Am. Jour. Hygiene*, *3*, 35 (1923).

[11] Darling, S. T., Barber, M. A., and Hacker, H. D.: *Rep. Uncin. Com. Orient.*, p. 191 (1920).

[12] Meyer, J. R., and Pessôa, S. B.: *Am. Jour. Trop. Med.*, *3*, 177 (1923).

Love [13] treated ninety cases of hookworm mostly in children. Of these 82 per cent. were freed from infection by the first dose, 13 per cent. required two doses and 4.4 per cent. three doses. Two of the children vomited the first dose. One patient who had been given over sixty doses of other anthelmintics (thymol; oil of chenopodium) was freed from hookworm by three doses of carbon tetrachloride.

Docherty [14] has made a clinical comparison between thymol, betanaphthol, oil of chenopodium and carbon tetrachloride, using 800 prisoners in order to insure absolute control of the patients while under treatment. The dose of carbon tetrachloride employed was 3 cc. followed in three hours by 50 cc. of saturated magnesium sulphate. The doses of the other drugs were such as are customarily employed as anthelmintics. By the method of comparison used and in the dosage employed, carbon tetrachloride proved the most efficient of the four vermifuges tested both in the percentage of cures and in the percentage of total worms removed.

Because of the strong likelihood that carbon tetrachloride would prove of value in medicine and because of the lack of standards for the identity and purity of the substance, the Council on Pharmacy and Chemistry took up its study with the view of its admission to New and Non-official Remedies. The literature of the chemistry of carbon tetrachloride was studied in order to obtain information concerning the impurities which would most likely be present in the market product.

Carbon tetrachloride is usually prepared by chlorinating carbon disulphide. Therefore the impurities most likely to be present in carbon tetrachloride are free chlorine and carbon disulphide. The reports of chemical examinations of carbon tetrachloride in the literature record the presence of carbon disulphide in several instances but none, apparently have recorded free chlorine as an impurity. Radcliffe [15] worked on known mirtures of pure carbon tetrachloride and carbon disulphide, containing up to 16 per cent. of the latter substance. His method, which was an adaptation of Gastine's procedure,[16] consisted in converting the carbon disulphide into potassium xanthate by treatment with cold alcoholic potassium hydroxide

[13] Love, J. D.: *Jour. Fla. Med. Assoc.*, *9*, 176 (1923).
[14] Docherty, J. F.: *Jour. Am. Med. Assoc.*, *81*, 454 (1923).
[15] Radcliffe, L. G.: *Jour Soc. Chem. Ind.*, *28*, 229 (1909).
[16] Gastine, G.: *Compt. rend.*, *98*, 1588 (1884).

solution, acidifying with acetic acid and titrating the liberated xanthic acid with tenth-normal iodine solution in presence of sodium bicarbonate, using starch solution as indicator. His results are given in Table I herewith:

TABLE I.

Analysis of Known Mixtures of Carbon Tetrachloride and Carbon Disulphide.

CS_2 *added.*	CS_2 *found.*
0	0
3.89	3.81
5.53	5.42
8.96	8.94
11.3	11.3
16.00	15.88

In 1909 Waller[17] found that a sample of "hair wash," which had caused the death of a young woman on whom it had been used as a shampoo, and which was composed essentially of perfumed carbon tetrachloride, was considerably more toxic to isolated muscle than a specimen of pure carbon tetrachloride. Veley[18] found the impurity in this toxic "hair wash" to be chiefly carbon disulphide, of which he estimated about 1.5 per cent. to be present. His methods of separation depended on careful fractional distillation and were admitted not to be very accurate. Willcox[19] testified that he had examined the shampoo above mentioned and that it contained in addition to carbon tetrachloride, 2.4 per cent. of carbon disulphide and 1.4 per cent. of water.

Chemical manufacturers were invited to submit specimens of their medicinal carbon tetrachloride together with the tests and standards by which the identity and purity of their products might be determined. The replies at first received indicated that none of the manufacturers listed brands of carbon tetrachloride for medicinal use, but that several of them advertised a brand which had been prepared for reagent purposes and which was stated to be of a high degree of purity. Brands intended for medicinal use were submitted later. In addition to the specimens submitted by certain of the manufacturers specimens were purchased on the market and

[17] Waller, A. D.: *Lancet, 177,* 369 (1909).

[18] Veley, V. H.: *Ibid.,* 370.

[19] Willcox, W. H.: *Pharm. Jour., 83,* 457 (1909).

two were received from Government officials. One of these latter was sent by Doctor Hall, of the Bureau of Animal Industry of the United States Department of Agriculture, and the other by Doctor Lake, of the Public Health Service. The specimen received from Doctor Hall was a portion of that used in his experiments in removing hookworms from lower animals mentioned earlier in this paper and the specimen received from Doctor Lake was the portion remaining after his experiments on monkeys described earlier in this paper. As neither of these specimens had been tested for impurities they were included in the examination. For the sake of comparison a specimen sold as "technical" was also included in the study.

Each of the specimens received was subjected to chemical examination. The tests included observation of the physical properties, such as color, specific gravity and boiling point, tests for acidity, chloride, free chlorine, aldehydes, organic impurities and carbon disulphide and determination of the residue on evaporation. Some of the tests were suggested by the manufacturers and some were obtained from the literature. The qualitative tests to which the specimens were subjected are as follows:

> Shake 10 cc. of carbon tetrachloride with 10 cc. of water. The aqueous layer should be neutral to litmus paper and should not give an opalescence with silver nitrate solution (*chlorides*).
>
> Shake 10 cc. of carbon tetrachloride with 10 cc. of water containing a few drops of potassium iodide solution. On standing for five minutes the lower layer should not be colored violet (*free chlorine*).
>
> Warm 10 cc. of carbon tetrachloride with 10 cc. of 25 per cent. potassium hydroxide solution. No yellow or brown color should develop (*aldehydes*).
>
> Mix 10 cc. of carbon tetrachloride with 10 cc. of sulphuric acid and shake occasionally for five minutes. Not more than a barely perceptible color should be present in either layer (*organic impurities*).
>
> Mix 10 cc. of carbon tetrachloride with 10 cc. of half-normal alcoholic potassium hydroxide solution and shake at intervals for two hours. Add 10 cc. of water and shake again. Draw off as much of the aqueous layer as possible and acidify slightly with diluted acetic acid. Add a few drops of copper sul-

phate solution. No precipitate should form (*carbon disulphide*).

None of the specimens examined gave any weighable residue on evaporation, and none responded to the tests for chlorides, free chlorine, aldehydes or organic impurities. Most of the specimens responded to the tests for carbon disulphide. Since, as previously mentioned, carbon tetrachloride may be made from carbon disulphide this substance may be found in commercial specimens of the drug. Because of the toxic properties of carbon disulphide its presence in any considerable amount in carbon tetrachloride intended for medicinal use would be undesirable. Carbon disulphide was determined quantitatively in such of the specimens as were found to contain it. Several methods have been suggested for determining carbon disulphide in benzene, carbon tetrachloride, etc. The method used in this study is an adaptation of that published by Weiss [20] for the determination of carbon disulphide in benzene. As carried out in this laboratory the method is as follows:

> About 5 gm. of the material are weighed, placed in a reflux apparatus with 20 cc. of half-normal alcoholic potassium hydroxide solution and the mixture gently boiled for thirty minutes. The solution is diluted with 50 cc. of water and 5 cc. of 20 per cent. alcoholic potassium hydroxide solution, the mixture warmed on the steam bath until the carbon tetrachloride and alcohol have been removed and 50 cc. of bromine water are added gradually to the alkaline solution. (An excess of bromine water must be used.) After warming for fifteen minutes an excess of hydrochloric acid is added and the solution filtered. An excess of barium chloride solution is then added and the barium sulphate collected, heated and weighed in the usual way.*

$$BaSO_4 \times 0.16308 = CS_2.$$

The findings from the several determinations are tabulated herewith:

[20] Weiss, J. M.: *Jour. Ind. Eng. Chem.*, *1*, 604 (1909).

*In determining carbon disulphide a blank determination for sulphur was made in the reagents, using 20 cc. of 2 per cent. alcoholic potassium hydroxide solution, 5 cc. of 20 per cent. alcoholic potassium hydroxide solution, 100 cc. of bromine water, 5 cc. of hydrochloric acid, and 5 cc. of barium chloride solution. The barium sulphate found weighed 0.0022 Gm. This correction was, therefore, applied to all weights of barium sulphate obtained.

TABLE II.

ANALYSES OF CARBON TETRACHLORIDE.

Brand	*Sp. Gr. 25°/25°*	*B.P.*	*Carbon disulphide*	*Claims*
P. W. R. Analytical Chemicals (Hall)	1.5887	76-76.2°	0.086	CS_2 0.1%
P. W. R. Analytical Chemicals (fr. Mfr.)	1.5897	76.4°	none	CS_2 none
Baker's Analyzed (Lake) ...	1.5886	76-76.2°	0.213	S comp. none
Baker's Analyzed (Purchased)	1.5888	76°	0.096	S comp. none
Central Scientific (Purchased)	1.5888	76-76.2°	0.052	C. P.
M. C. W. Technical (Purchased)	1.5879	75.9-76.2°	0.223	Technical
M. C. W. Redistilled (fr. Mfr.)	1.5888	——	0.108	Pure Redistilled
M. C. W. Medicinal (fr. Mfr.)	1.58895	76-76.2°	0.015	C. P. Medicinal
H. K. Mulford capsules (fr. Mfr.)	——	——	0.271	——

A comparison of these results with the meager reports of earlier examinations indicates that the brands of carbon tetrachloride of the present market are of a greater degree of purity than they formerly were. They indicate, too, that manufacturers are making an effort to reduce the quantity of carbon disulphide in their products. For example, one specimen of the P. W. R. brand which was known to be at least one year old was admitted (by the label) to contain 0.1 per cent. of carbon disulphide, whereas a recent specimen contained none. One specimen of the Baker's analyzed brand which was at least one year old and which was claimed to contain no sulphur compounds, was found to contain over 0.2 per cent. of carbon disulphide. In a recent specimen the amount of this impurity had been reduced to less than 0.1 per cent. although the label still declared sulphur compounds to be absent. As long ago as 1914 Lehner [21] pointed out that reliance could not be placed on the claims made for "Analyzed Chemicals." The specimen from H. K. Mulford and Company was in the form of capsules. The content of the capsules was very high in sulphur. No specimen of carbon tetrachloride Mulford was received in bulk so that no judgment could be made concerning the purity of the carbon tetrachloride originally used in preparing the capsules.

Based upon the results of this examination, standards for the identity and purity of carbon tetrachloride were adopted by the

[21] Lehner, V.: *Jour. Ind. Eng. Chem.*, *6*, 603 (1914).

Council on Pharmacy and Chemistry which required a clear, colorless, liquid, having a specific firavity of not less than 1.588 at 25 C./25 C., which should be free from chlorides, free chlorine, aldehydes and organic impurities, which should not give more than 0.001 gm. of residue from 25 cc. on evaporation, and which should not contain more than 0.1 per cent. of cardon disulphide.

The description for carbon tetrachloride as adopted by the Council on Pharmacy and Chemistry for New and Non-Official Remedies is as follows:

Carbon Tetrachloride Medicinal.—*Carbonci tetrachloridum medicinale.*—Tetrachlormethane.—CCl_4

Actions and Uses.—Carbon tetrachloride has narcotic and anesthetic properties somewhat similar to those of chloroform. It has recently come into use as a vermifuge in the treatment of hookworm disease. It also removes some intestinal parasites other than the hookworm, such as *Oxyuris vermicularis, Ascaris lumbricoides* and *Trichocephalus dispar,* but it is less effective against these worms than some other drugs, such as oil of chenopodium. It is reported that usually about 95 per cent. of the hookworms are removed by the first dose of carbon tetrachloride and that occasionally all are removed. As a vermifuge it appears to be relatively safe, but serious symptoms and even death have been reported, especially in patients addicted to the use of alcohol. The best results are obtained by administration in water or milk or in gelatin capsules on an empty stomach, followed in 3 hours by a purgative dose of magnesium sulphate. The capsules may be prepared extemporaneously. A mild laxative is generally given to constipated patients on the day previous to treatment. To insure complete removal of the hookworms a test dose of oil of chenopodium, 3 cc. (45 minims) may be given a week after the treatment with carbon tetrachloride. A second dose of carbon tetrachloride medicinal should not be given within three weeks. Alcohol should not be taken during treatment.

Dosage.—From 2 to 3 cc. (30 to 45 minims). Children 0.13 cc. (2 minims) for each year of age up to fifteen years. The dose of 3 cc. should not be exceeded.

Carbon tetrachloride is a clear, colorless, mobile liquid, having a characteristic, ethereal odor somewhat like that of chloroform;

almost tasteless. Carbon tetrachloride is almost insoluble in water and glycerine; miscible with alcohol, chloroform, petroleum benzin and benzene; also soluble in most of the fixed and volatile oils. Specific gravity not less than 1.588 at 25 C. Carbon tetrachloride is volatile at ordinary temperature, but is not inflammable. Medicinal carbon tetrachloride boils at from 76 to 77 C.

Shake 10 cc. of carbon tetrachloride medicinal with 10 cc. of water. The aqueous layer should be neutral to litmus paper and should not give an opalescence with silver nitrate solution (*chloride*). Shake 10 cc. of carbon tetrachloride medicinal with 10 cc. of water containing a few drops of potassium iodide solution. On standing for five minutes the lower layer should not be colored violet (*free chlorine*). Warm 10 cc. of carbon tetrachloride medicinal with 10 cc. of 25 per cent. potassium hydroxide solution. No yellow or brown color should develop (*aldehydes*). Mix 10 cc. of carbon tetrachloride medicinal with 10 cc. of sulphuric acid and shake occasionally for 5 minutes. Not more than a barely perceptible color should be present in either layer (*organic impurities*).

Evaporate 25 cc. of carbon tetrachloride medicinal almost to dryness in a weighed dish on a steam bath Allow the balance to evaporate spontaneously. The residue, if any, should be odorless. Dry the residue at 100 C. and weigh. The residue should not weigh more than 0.001 gm. About 5 gm. of carbon tetrachloride medicinal are weighed, placed in a reflux apparatus with 20 cc. of half-normal alcoholic potassium hydroxide and the mixture gently boiled for 30 minutes. The solution is diluted with 50 cc. of water and 5 cc. of 20 per cent. alcoholic potassium hydroxide solution, the mixture warmed on the steam bath until the carbon tetrachloride and alcohol have been removed and 50 cc. of bromine water are added gradually to the alkaline solution. (An excess of bromine water must be used.) After warming for 15 minutes an excess of hydrochloric acid is added and the solution filtered. An excess of barium chloride solution is then added and the barium sulphate collected, heated and weighed in the usual way. The weight of barium sulphate obtained should correspond to not more than 0.1 per cent. of carbon disulphide.

Chemical Laboratory of the American Medical Association.

INVISIBLE LIGHT.*

By Henry Leffmann, A. M., M. D.

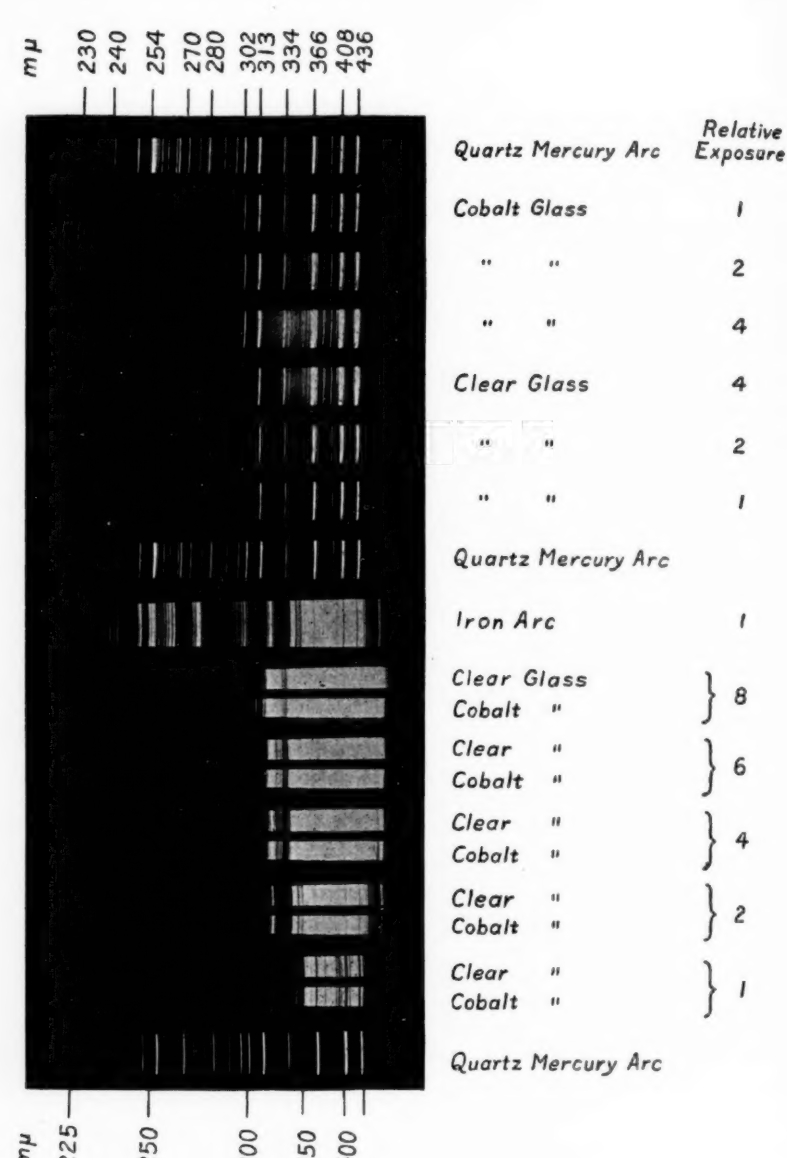
Lecturer on Research, Philadelphia College of Pharmacy and Science.

"Invisible light." The term seems ill-chosen, for light is essentially the form of energy connected with visibility. Indeed, a step has been taken lately to eliminate the paradox, by using the terms ultra-violet and infra-red "radiation." No doubt some such designation will before long be in general use among scientists, but technical phrases are not very acceptable to the non-scientific portion of the community.

The nature of light was not definitely known until about the time when William Penn was preparing to found the city of Philadelphia, when Isaac Newton discovered that by passing a beam of light through a prism, all the known colors were exhibited. He made his experiment in a dark room, the beam of light coming through a hole in a shutter. He noted that the beam was bent from its course, violet to the greatest extent, red the least. The colors were somewhat arbitrarily distinguished; conventionally, they have been given in the order: violet, indigo, blue, green, yellow, orange, red. Great advances have been made from Newton's time in the knowledge of color relations, and it is now known that a few colors can be so chosen as to make any color or shade desired. In photography and in printing vivid results are obtained by the judicious use of a few color screens.

By using a comparatively large opening for the beam of light, Newton was prevented from observing a very interesting and important feature of the "solar spectrum," as the sheet of color he obtained from sunlight is called. Wollaston, an English scientist, using a narrow opening, observed that the spectrum is crossed by numerous dark lines, indicating that certain tints are missing. He did not investigate the matter to any extent, but later, Fraunhofer, a Munich optician, mapped some of the more conspicuous lines and designated them by letters of the alphabet. Newton thought that the visible spectrum represented the entire range of the beam of white light that was passing through the prism, and such was the

*Abstract of a Lecture delivered October 11, 1923, at the Philadelphia College of Pharmacy and Science, being the first lecture of the popular course for 1923-1924.



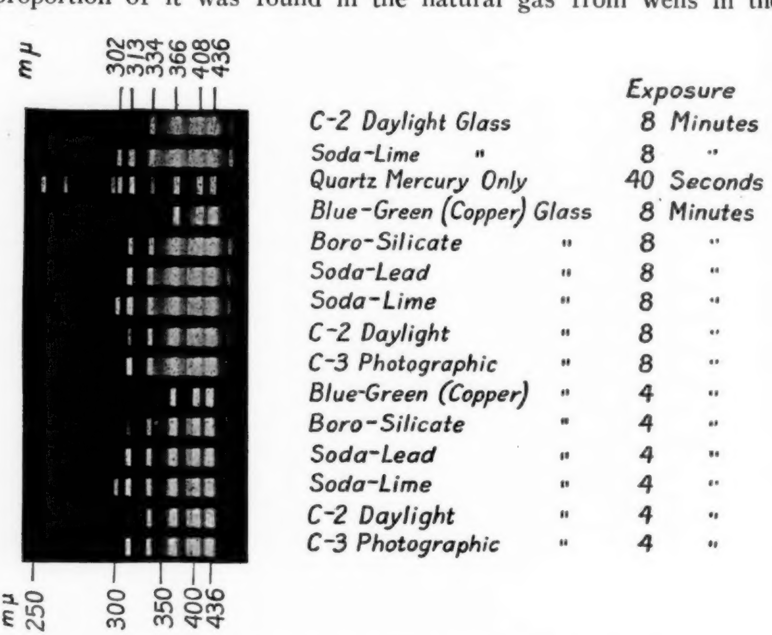
Transmission by clear and cobalt glasses of rays from bare iron arc and quartz mercury lamp. Wave-lengths in micro-microns. From paper by Luckiesh, Halladay & Taylor. (**J. Frank. Inst.,** 1923, v. 196, 353.) **Courtesy of The Franklin Institute.**

opinion held by scientists for over a century. In the first decade of the nineteenth century, Sir William Herschel discovered that beyond the visible red are rays that have definite effects. About the same time Johann Wilhelm Ritter discovered rays beyond the violet. Since these discoveries, the nature and properties of the invisible rays have been extensively studied and it is known that they extend in both directions far beyond the visible spectrum.

The nature of light has, of course, been always a matter of interest to scientists. Aristotle had a theory about it. Newton regarded it as due to the transmission of corpuscles through space, but for many years the accepted view has been that it is due to vibrations, somewhat analogous to those which transmit sound, but differing therefrom in important points. Sound waves are transmitted through the air or other material which connects the sounding body to the ear, but light does not appear to be so transmitted. Sound waves are propagated from place to place at about 1140 feet per second; light travels 186,000 miles in the same time. The rate of vibrations, that is, the number of to and fro motions per second for sound ranges from sixteen per second to about 25,000, but light vibrations run up to many millions. The length of the light wave is taken as the datum of distinction. This is now usually expressed in a specific unit, termed the Ängström unit, represented by Ä. It is one ten-millionth of a millimeter. Many physicists, however, use the micro-micron, which is the millionth of a millimeter. Each micro-micron, therefore, is equal to ten Ä. The visible spectrum reaches from about wave-length 4000 Ä (violet) to 8000 Ä (red). The X-rays, now so much used in medical practice, are ultra-violet and very short; radio transmission waves are far beyond the visible red and very long. The dark lines, seen in the spectrum of the sun and of many fixed stars, have been recognized as due principally to the interfering action of highly-heated gases, and are thus indicative of the elements that have produced these gases. It has been further ascertained that solid objects if emitting light, produce a continuous spectrum without dark lines, so that it is now possible to determine whether a celestial object is solid or gaseous. By extended research, many of the lines have been identified as due to particular elements. A double dark line in the yellow is known to indicate sodium. When sodium compounds are heated strongly, similar yellow lines are seen. Very small amounts of material are sufficient to give distinct lines in a properly

constructed apparatus. This instrument, termed a spectroscope, has been of great advantage in both chemistry and physics.

In a total eclipse of the sun that occurred in 1868 J. Nòrman Lockyer, a British astronomer, observed in the outer portion of the sun's atmosphere an orange band that he could not refer to any known element. He, therefore, assumed that it was due to an element existing in the sun, and provisionally called it "helium," from the Greek word for sun. Many years afterwards this element was found in minute amount in a rare mineral, and still later, a notable proportion of it was found in the natural gas from wells in the



Transmission of rays from quartz mercury lamp through different lamp-bulb glasses. From paper by Luckiesh, Halladay & Taylor. (J. Frank. Inst., 1923, v. 196, 353.) Wave-lengths in micro-microns. **Courtesy of The Franklin Institute.**

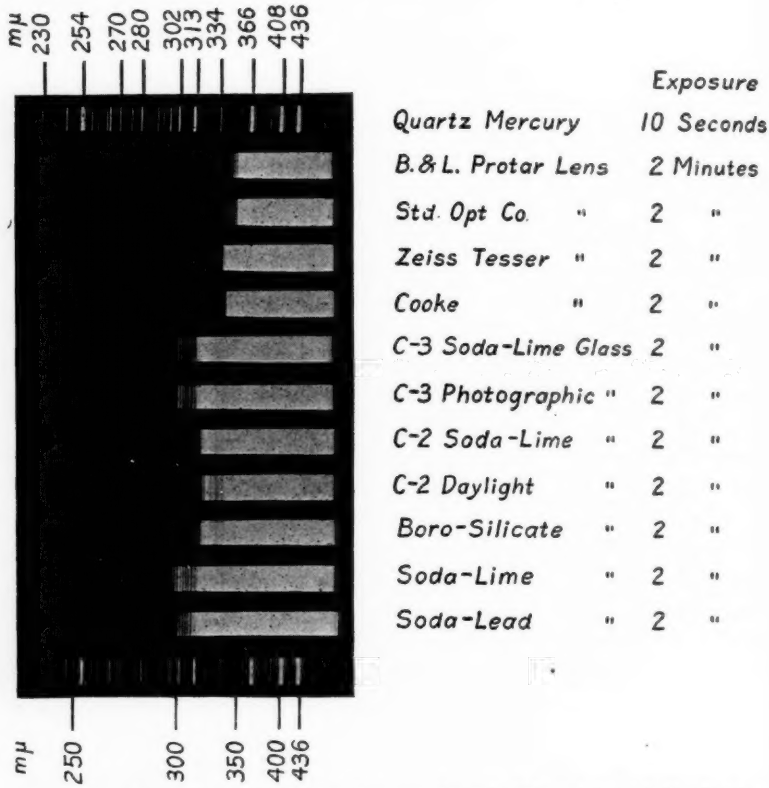
middle southwest of the United States. Large quantities of helium are now available and it is used for filling United States dirigibles, as it is the lightest substance known except hydrogen and is non-inflammable.

The study of the infra-red and ultra-violet rays has been pursued of late years with much activity. Ultra-violet rays are obtained in several ways. They exist in sunlight but not in large amount. Electrical discharges at high voltage, especially from iron, cadmium

or mercury terminals, give a good range of such rays. The Cooper-Hewitt mercury arc is rich in them. The rays, however, do not pass freely through many substances. Glass, mica, all films used for motion picture work, gelatin and many other materials perfectly transparent to ordinary vision obstruct completely the transmission of the rays. The very short vibrations are obstructed by air so that researches in this part of the spectrum must be conducted in a vacuum. Quartz, fluor spar, and some pure cellulose products transmit these rays. Infra-red rays, which have apparently not been studied as extensively as the ultra-violet show higher powers of penetration through ordinary transparent objects, indeed, in the extreme field of infra-red remarkable powers of penetration exist. The waves employed in wireless telephony and broadcasting are infra-red of very great length, and penetrate thick walls, for it is possible to hear the ordinary broadcasts from aerials stretched in closed rooms and cellars.

As the rays beyond the visible spectrum are wholly invisible to human eyes, the question at once arises how do we know of their existence? They are detected by their actions on various substances. For instance, substances exist that have the power to reduce the rate of vibration, so that they are brought within the range that the human eye can perceive. Such substances are termed "fluorescent." Willemite, a natural form of zinc silicate shows this property to a high degree. Several coal-tar colors are strongly fluorescent even in dilute solute solution. One such compound is called "fluorescein" on account of its activity. Solutions of quinine, especially the sulphate, have distinct fluorescence. Horse-chestnut bark contains a crystalline principle "esculin" that shows the property to a moderate degree.* Many fluorescent substances are capable of acting under the influence of ordinary light, but the accessory light interferes with the brilliancy of the effect, hence it is most vivid when excited by ultra-violet radiation alone, which can be carried out in darkness, and the fluorescent substance seems to be emitting light. Many brilliant effects can be produced by this means. The electric spark, when transmitted through tubes nearly exhausted of air can pass over a considerable distance, and is usually accompanied by considerable ultra-violet radiation, so that fluorescent substances placed in such tubes show vividly when the spark is passed. As glass does not transmit these short waves, the substance must be placed inside the tube. Its fluorescence is due to emission of rays

visible to the human eye, which can pass through glass, and therefore, it seems to be self-luminous. It is merely taking up the invisible light and rendering it visible. Among the substances that have this property of fluorescing under electric discharges in vacuum are compounds of uranium. Glass colored with uranium is yellowish-green under ordinary light but assumes under the electric discharge a deep green brilliant tint.



Transmission of rays from bare iron arc through different lamp-bulb glasses and photographic lenses. Wave-lengths in micro-microns. From paper by Luckiesh, Halladay & Taylor. (**J. Frank. Inst.,** 1923, v. 196, 353). **Courtesy of The Franklin Institute.**

Ultra-violet light acts promptly on the ordinary photographic emulsions, hence it can be easily detected by these. The range of susceptibility of such emulsions extends to a considerable distance, for X-rays, which are very short, produce, as is well known, very distinct pictures after brief exposure. The penetrability of X-rays is also a striking property, passing through almost all opaque mate-

rials except metals. Bone resists some of the rays, but by using a high-power tube, generally called a "hard" tube, penetration even of bone may be obtained.

Ultra-violet rays are injurious to most, if not all living organisms. Such light will coagulate albumin. Brief exposure of the eye to it will result in blindness, and even the ordinary skin may be injured. On the other hand, brief exposure of skin affected with certain diseases has been found to be beneficial. Extensive application has been made of ultra-violet rays in the treatment of some diseases.

Infra-red rays seem to have been much less extensively studied than the short waves. They have more or less heating effect, and are directly connected with the heat portion of the spectrum. They pass through many substances, including glass, mica and other transparent materials. They can be separated from white light by means of screens. A red screen is now furnished by dealers which transmits only infra-red rays. Peculiar effects are obtained when ordinary landscapes are photographed. Trees in full leaf give pictures in which the leaves appear as if covered with snow. During the late war use was made of screens of this nature to distinguish between real and camouflaged foliage. It was a practice of the belligerents to cover the ground with painted strips to deceive airplane raiders, who would think that the view was that of foliage concealing cannon or ammunition, and waste bombs on it. By means of a screen, devised in the Eastman laboratory, the aviator could distinguish between real leaf-green and green paint.

Infra-red interferes to some extent with the ultra-violet, and even with effects of visible light. Several luminous phenomena are developed, as noted above, by visible light, but more strikingly by ultra-violet light. These are especially, fluorescence and phosphorescence. Fluorescence as already noted, is regarded as due to a reduction of wave-length, by which the invisible wave is brought within the limit of human vision. Phosphorescence is the storing up of light. The substance shines for a variable time—generally short—after the light is removed. Some forms of phosphorescence are, however, merely slow combustions, and are not due to any absorption of light. Such are the glow of phosphorus itself and the light of the glow-worm and firefly. The glow, often quite brilliant, exhibited by rotting wood (fox-fire) is also due to chemical action and is not true phosphorescence. The term should be limited to those

instances in which no appreciable chemical change occurs in the glowing substance, but the action seems to be due to an actual storing up of light, the substances not showing any light unless previously exposed to either visible or invisible rays. Several metallic sulphides, especially of zinc and calcium exhibit this true phosphorescence. It appears that these do not act well unless somewhat impure. Absolutely pure materials are inactive. If a surface coated with calcium sulphide properly prepared, is "activated," that is, exposed to light until it acquires marked phosphorescence, which, of course, should be observed in the dark, is then subjected to the action of light passing through a red screen, the phosphorescence is destroyed. In some biologic researches, it has been found that infra-red light interferes with the action of the ultra-violet. On the other hand it is claimed that infra-red rays have high penetrating power in living tissue and are useful for therapeutic purposes.

Although a good deal of work has been done in the field of invisible light, it is evident that a vast amount of interesting and useful information still awaits discovery and application.

WHY STUDY CHEMISTRY.*

By Charles E. Munroe, Ph. D., LL. D.

Professor Emeritus of Chemistry and Dean Emeritus of the School of Graduate Studies, George Washington University, Washington, D. C.

(Note of Transmission by J. Norman Taylor, Washington Preparatory School, Y. M. C. A., Washington, D. C. With his permission I transmit the manuscript of a discourse given by Professor Munroe before my students. I do this with the thought that other teachers and students of chemistry and the allied sciences should have the opportunity of sharing with us this talk from one who not only commands the respect of his profession, but also has the affection of all who have the privilege of knowing him—one of Nature's noblemen.)

Chemistry is that branch of physical science which deals with matter in all its forms, its conditions, and its manifestations wher-

*An address used by Professor Munroe for many years as an annual opening address to his beginners' class in Chemistry at the George Washington University. With the exception of the last few paragraphs it was presented to my students at the Washington Preparatory School as formerly used, without bringing the census statistics up to date. Although more than a decade has gone by since, as a Freshman, I sat at the feet of this teacher, the reasons so clearly presented by Professor Munroe obtain today with even greater force as to "Why Study Chemistry?"—J. NORMAN TAYLOR.

ever occurring. Consciously or unconsciously every person is influenced and controlled by matter and the chemical reactions taking place between matter. It is, therefore, a science with which everybody is concerned and it should appeal to and interest every one as a subject of study. Nevertheless, I shall make use of the privilege of this first meeting with you to dwell somewhat specifically upon the various reasons why every one should study chemistry and I shall endeavor to set forth some of the many advantages which should accrue to each from doing so.

Chemistry as a study may be pursued

1. For its economic value; that is as furnishing a means of livelihood. Although this is the least worthy motive I mention it first as it is often a most active determining motive for the pursuit of this study since the majority are compelled to earn their bread by labor. As examples of the opportunities which this profession affords, I may note that today chemists are employed not only as teachers and as commercial analysts and assayers but also as analysts, investigators and superintendents in works where acids, alkalies and salts are made; in explosives factories; in metallurgical works (especially about blast furnaces, for iron and smelters, for copper, lead, tin, zinc and other metals), steel works, and refineries where the commoner metals are refined and the precious metals recovered; in dye works, paper works, gas works, in soap works, in fertilizer works, oil refineries, at agricultural experiment stations, in pharmaceutical works, as assayers in the mints of the United States and with individuals and corporations engaged in isolating the precious metals; as analysts to the great railroads which traverse our territory; as inspectors for the army and navy; as associates with physicians in determining the character and extent of disease in their patients; as associates of State and city Boards of Health; as inspectors of the materials used in buildings and roadways for many of our large cities, and in a great number of other ways too numerous to mention. From the returns of the United States census for 1900, when the last canvass of this kind was made, there were 8847 persons practicing in the United States as chemists, assayers and metallurgists. It is probably not far wide of the mark to assert that there are more than 25,000 chemists usefully employed in the United States today and the advantage which follows their employment has been made so obvious that the demand is constantly increasing.

A special reason for this lies in the active competition for trade which is going on within and without our country, for it has been proven that to successfully manufacture any article dependent on chemical change the operations must be carried on under strict chemical supervision. Take the iron and steel industry as an example. Originally and until recently the iron was extracted from its ores and converted into steel in a wholly empirical manner with the result that the product was of a most variable character, the waste at all points was great, and accidents, which often involved great losses, were frequent. Today no wise man would expect to reach commercial success in this industry unless he employed a corps of chemists to chemically supervise the operations and to test the materials at every step in the process. For instance, analyses are made of the ore, the fuel, and the flux, which go into the blast furnace and of the iron, the slag and the gases that come from it; at the convertor, or open hearth, the spiegel iron, or ferro-manganese, which is added to the molten iron is analyzed and likewise the first step, after the blow is completed or the melt is brought to nature, is to take a sample of the product to the chemist to be tested before working it to shape. As proof of the importance of all this we have the statement of Mr. Carnegie to the effect that he owed his success in the steel manufacture, and the enormous fortune that he accumulated, largely to the fact that he was one of the first steel manufacturers to employ a corps of chemists in his works. It is of interest to note, too, that in the published biographies of the two young men who successively rose to the important position of president of the United States Steel Company it is stated that they studied chemistry to fit them for especial usefulness in their various duties, and I do not recall that any other subject of study was mentioned.

The cultivation of chemistry from this standpoint has been given an especial impetus by the immense strides which Germany made in the industrial field through which her manufacturers succeeded in capturing the trade of the world for many products. This progress was such as to cause grave concern in France, the United States, and especially in England. Numerous conferences were held and investigations made regarding the sources of her success, since, as she enjoyed no special advantages of location, cheap transportation, cheap food, cheap fuel or cheap raw material, except potassium salts, these were not readily apparent, and they were found to

be due largely to the fact that she was employing trained scientific men, and especially chemists, to a much larger extent in her manufacturing enterprises than obtained elsewhere in the world, and that by this she surmounted her disadvantages. As an example of the unparalelled extent to which this employment of specially-trained scientific men was carried we find our consul at Chemnitz to state that in one German factory, the Badische Anilin and Soda Fabrik, 450 chemists, university-trained men, were working under the direction of the famous chemist Bernthsen, and that thirty-nine of them were engaged in Doctor Bernthsen's special research laboratory. One-fifth of this corps of chemists attended to the routine analytical work of this one concern, while the remainder prosecuted researches along the lines of manufacture. According to Baskerville,[1] in 1900, the salaries of these chemists, excluding the chief, varied from $1000 to $5000 each a year.

In discussing this issue and referring to one of these factories Sir Henry Roscoe[2] said:

> "One chemist was employed at $5000 a year, who worked for several years without producing any results but eventually through his researches he made a discovery which repaid the firm ten times over and gave them control of an entirely new branch of manufacture."

These citations indicate an additional economic advantage which the study of chemistry affords, for the knowledge thus acquired enables one to increase the quantity, or improve the quality, or cheapen the cost in manufacturing.

As illustrating to some extent the opportunity for this application of chemical knowledge permit me to cite statistics from the United States census of 1909. For several of the recent censuses it has fallen to my lot to collate and discuss the statistics of the so-called chemical industries. This category as set forth in census classification relates only to such substances as are styled chemicals in market reports yet the product for these articles alone at the census of 1909 amounted in value to $424,941,000. But chemists classify as chemicals[3] in their chemical technologies all substances which are produced by a chemical change or reaction, therefore we

[1] *Chemical Economics*, p. 8, 1900.

[2] *J. Soc. Chem. Ind.*, 16, 570, 1897.

[3] This Journal, 755, 1923.

may also properly include under this heading the following articles of manufacture:

Table: Value of additional chemical products at census of 1909.

VALUE OF ADDITIONAL CHEMICAL PRODUCTS AT U. S. CENSUS OF 1909.

Iron and steel from blast furnaces and steel works	$1,377,152,000
Other metals from smelters and refineries	604,030,000
Liquors and beverages	488,841,000
Chemicals and allied products	424,084,000
Bread and bakery products	396,865,000
Sugars	376,160,000
Products of petroleum refining	236,998,000
Alloys	169,757,000
Illuminating gas	166,814,000
Patent medicines and compounds	141,942,000
Soap	111,358,000
Manufactured fuels, charcoal and coke	95,880,000
Glass	92,095,000
Dyeing and finishing textiles	83,556,000
Turpentine and rosin	25,295,000
Lime	17,952,000
Blacking, cleansing and polishing preparations	14,769,000
Glue	13,718,000
Ink, printing and writing	11,370,000
Salt	11,328,000
	$4,859,964,000

But even this enumeration and amount does not by any means represent the limit for there is not any industry of all those producing the $20,672,052,000 of products sent forth from our factories and workshops in 1909 that could not be advantageously subjected to chemical supervision. Today our architects and engineers are purchasing their supplies on chemical and physical specifications and this custom is extending to all well-conducted industries. More than thirty years ago German banks employed expert chemists to investigate and appraise industries seeking loans and within the past few years our own banks have begun to do likewise. I expect that the time is not far distant when even the large retail stores will make their purchases subject to chemical and scientific supervision. In my investigation of the chemical industries I have made inquiries into the existing practice as regards the employment of chemists and found in 1900 that we by no means approached Germany, espe-

cially as regards the employment of research chemists. But a gratifying improvement has taken place in the intervening years. Yet if we are to meet competition our manufacturers must adopt this practice still more widely and I believe that they surely will.

Another means by which we may gain some idea of the large possibilities which industrial chemistry offers to the intelligent, industrious and trained man is by viewing this chart which is the original of that published with my address to the American Institute of Chemical Engineers on the Chemical Industries of America in 1909. To produce this chart there have been located on a map of the United States all of the establishments engaged at the census of 1904 in the manufacture of sulphuric acid, green squares, or explosives, red circles, or wood distillation products, black triangles, (three of the most fundamental and most widely-practiced of the chemical industries), and it is amazing to see how large an area of our country still awaits the coming of the chemist to bring it to fruitfulness. Should you desire a more extended view of the growth of chemical industries I commend to your attention the admirable reports on the chemical industries of Denmark, Holland, Norway and Sweden rendered by Thomas H. Norton, Ph. D., United States Consul at Chemnitz, to the Bureau of Manufactures. They are thought so highly of that not only have they been republished in many journals but they have been translated into the foreign languages for publication in book form.

It may be proper here to call your attention to a note of warning regarding the consequences of this striving for knowledge to apply to the solution of material problems which has been recently sounded by Price Collier when writing in 1913 in commenting on the tales of suicide and despair of schoolboys in Germany he says:

> "It is to be remembered that not to reach a certain standard here means that a man's way is barred from the army and navy, civil service, diplomatic or consular service; from social life, in short. The uneducated man of position in Germany does not exist, cannot exist. This is, therefore, no phantom, but a real terror. The man of twenty-five who has not won an education and a degree faces a blank wall barring his entrance anywhere; and even when, weaponed with the necessary academic passport, he is permitted to enter, he meets with an appalling competition, which has peopled Germany with educated inefficients who must work for next to nothing, and who keep down the level of the earnings of the rest because there is an army of candidates for every vacant position. On the other

hand, the industries of Germany have bounded ahead, because the army of chemists and physicists of patience, training and ability, who work for small salaries provide them with new and better weapons than their rivals.

"There are two sides to this question of fine-tooth-comb education. Its advantages both America and England are seeing every day in these stout rivals of ours; but its disadvantages are not to be concealed, and are perhaps doing an undermining work that will be more apparent in the future than now it is. The very fact that an alien, an oriental race, the Jews, have taken so disproportionate a share of the cream of German prosperity, and have turned this technical prowess to purposes of their own, is, in and of itself, a sure sign that there may be an educated proletariat working slavishly for masters whom, with all their learning and all their mental discipline, they cannot force to abdicate."

2. The study of chemistry enlarges one's vocabulary.

In the endeavor to describe the enormous number of different kinds of matter, which exists in nature or may be produced in art, through their several properties and gradation of properties and through the transformations they may be made to undergo and the phenomena in which they may take part, a large number of terms are employed, and to convey or record this information accurately these terms must not only be used with precision but in such a manner and with such qualifications as to set forth all shades of gradations of properties and every degree of variation of phenomena. At the outset there must be an agreement as to the meaning a term or phrase is to possess and it must henceforth be always used with this conventional meaning. As a consequence this science possesses and uses a very extensive vocabulary so that its study enriches the vocabulary of the student, while practice in its methods of statement leads to a more exact use of terms and therefore to clearer thinking and more lucid methods of expression. Apart from the general benefit which results from this increased fund of information and this extension of one's vocabulary it has repeatedly occurred in my experience with students that this has frequently been of direct special benefit. Thus since those seeking the bachelor's degree in science at the university were required to satisfactorily complete certain work in chemistry many persons who possessed no natural aptitude or inclination for the study were reluctantly compelled to fulfil these requirements. Often I have heard complaints of the hardships that this entailed and queries as to the

mysterious reasons which led to this infliction. Yet in repeated instances, students of this class have come to me a year or several years later and said, "I cannot tell you how glad I am that I was required to take the course in chemistry. It seemed to me perfectly dreadful at the time and I never could understand why my degree was made dependent upon it, or what earthly use it ever could be to me, but I have just received an appointment (or it may be a promotion in office) because I had taken this course and understood something of chemical signs, symbols and terms and the methods of expression used in chemistry." Many of these persons were women and in no case was the office secured that of a chemist, yet it was the possession of this information which determined the selection of these persons from among others possessing the other qualifications necessary for the performance of the duties of the new office.

3. The study of chemistry is of value, too, as a means of culture, for it greatly widens out mental horizon and it makes the invisible apparent to our senses. Being an experimental science it develops the powers of observation. In qualitative chemical analysis we have an example of the severest system of logic; a system in which we are required not only to prove the positive but also the negative. In chemistry, too, we find some of the best opportunities for the application of mathematics and as the quantitative determinations of factors increase in precision and number the use of more and more abstruse mathematics in the solution of its problems becomes possible. It cultivates neatness, order, repose of manner and mental poise for unless these qualities are exercised in experimental work the results will be of little or no value. In an experience in teaching chemistry covering fifty years and dealing with several thousand students I have been especially impressed by this. In fact I know of no better training for the development of executive ability, though I have spent eighteen years of my life in institutions for educating officers for our navy and am thoroughly familiar with the military methods that are regarded as ideal in this respect. For in the first place laboratory work and especially qualitative analysis is a constant drill. Second, to succeed, before you begin your work, you must thoroughly understand what you seek to accomplish and you must plan your work in advance with that end in view. Third, you must pursue your work in a thor-

oughly systematic manner. Fourth, you must give your entire attention to the work in hand, you must concentrate. Fifth, all your senses must be at command, they must be alert to observe and note any phenomena that may occur. Sixth, you must go about your work calmly and keep cool and unperturbed that you may observe accurately. (I know of no circumstances under which the old maxim, "More haste less speed," so truly holds as in this pursuit), and, seventh, you must cultivate "at the time" the most valuable habit of making records—that is of taking original notes "on the spot."

Many notable instances of men trained in chemistry being called to high executive office may be mentioned. Among them are the two presidents of the United States Steel Company already mentioned. Presidents Eliot of Harvard, Crafts and Noyes of the Massachusetts Institute of Technology, Remsen of Johns Hopkins, Drown of Lehigh, Venable of the University of North Carolina, Smith of the University of Pennsylvania, were all eminent chemists. At the same time, the positions of Minister of Foreign Affairs of France and of Prime Minister of England (the two highest executives in these two foremost of nations), were held by chemists. The first by Berthelot, a chemist by vocation; the second by Lord Salisbury, a chemist by avocation.

On the other hand I have found that men possessing marked executive ability, either native or developed by training, such as the military training alluded to above, easily achieve success in routine laboratory work, and, (when broadened by cultivation) in experimental investigation. It is noticeable that they go about their work without fuss. They listen attentively and intelligently to verbal instructions and read the printed ones as they would an order from the officer in command. And they give the work in hand their entire attention, with the consequence that they reach the result surely and speedily.

4. The study of chemistry is worth pursuing since it supplies one with the means for improving the condition of mankind by ameliorating his environment. This in itself supplies an incentive to its pursuit which is most praiseworthy. As examples of this application we may cite the work of Mrs. Richards, of Boston, and the women who were associated with her in the solving of most perplexing domestic problems by its aid and in pointing the way to more correct living; the work of the chemists of the boards of

health who are tracing the sources of pollution of air, water and food so that these sources may be diverted; the work of Atwater and Chittenden on the metabolic processes going on in digestion and of Wiley on the effect of food preservatives; the work of the agricultural chemists by which the fertility of the soil has been notably increased and the conditions of rural industries greatly improved; the work of the organic chemists through which new remedies of great benefit to mankind have been discovered; the work of the physical chemist, like Mlle. Curie, by which marvelous sources of energy are disclosed, and the work of the physiological chemists by whose aid the character and extent of the diseases which ravage the human body are being ascertained with a high degree of certainty and the proper remedy indicated. Yet those are but a very, very few of the notable instances in which chemistry is applied to the relief of man.

5. Chemistry must concern all not only because we are completely subject to its laws and our lives depend for every moment of our existence upon the orderly progress of the many chemical reactions going on within and throughout our bodies, but also because every commercial transaction in which we take part, except barter, is based upon a chemical analysis. This may probably be the most surprising to you of the many statements made you in the course of these remarks, yet such is the case.

6. One may study chemistry from patriotic motives, hoping to serve the nation's needs, both in peace and in war. The World War, which doomed mankind to almost unbelievable suffering, taught much—but especialy the immense importance of chemistry. We have heard this last war spoken of as a "Chemical War," and it most certainly was. It was a war of explosives, poison gases, metals, fuels and innumerable other substances having their origin in chemical independence. And, as I pointed out in an address to the American Institute of Chemical Engineers in 1909, independence of nations involves chemical independence. There is nothing new in this statement, however. History records the bitter needs of nations in great distress from lack of chemical preparedness. Doctor Haller, of France, in his address on the "French Chemical Industry During the War" [4] reviewed the tremendous achievements

[4] *Bulletin de la Société D'Encouragement pour L'Industrie Nationale*, *132*, No. 6, pp. 761-825.

in building up the chemical industry in that country which were necessary for national defense and pictured the almost superhuman labors necessary to accomplish them. Thus in 1914, France faced the same condition of unpreparedness which obtained in 1797 when it was sorely beset by enemies without and within. Today we are attempting to impress upon our own country this same need for preparedness.[5]

7. Finally, we may study chemistry in the light of progress with the purpose of handing down to succeeding generations our inheritance together with our own contributions, ever remembering that progress is made by beginning where our predecessors left off. I was especially impressed with this trust while reading, not long ago, Professor Keyser's address to the Phi Beta Kappa Society in which he refers to Count Korzybski's recently published book, "The Manhood of Humanity: The Science and Art of Human Engineering," for in it man is given a new place in biological classification. Man possesses a gift not given to plants and animals—namely, that of initiating and continuing the movement of civilization. Permit me in closing to quote excerpts from Professor Keyser's remarkable address:

> "Plants . . . take in, chemically transform, organize and appropriate the basic energies of sun, soil and air; but they have not the *autonomous* power to move about in space; together they constitute the lowest order or class or type or dimension of life." They are "the basic—energy-binding, or chemistry-binding, class of life. . . . Like the plants, animals, too, take in, transform, organize and appropriate the energies of sun, soil and air, though in large part they take them already prepared by the plants; but unlike the plants, animals possess the *autonomous* power to move about in space—to creep or crawl or swim or run or fly; it is thus evident that, compared with plants, animals belong to a higher type or dimension of life; . . . because they are distinguished by their autonomous power to move, to abandon one place and occupy another and so to appropriate the natural fruits of many localities, the animals are called space-binders—the space-binding class of life."
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> Human beings also have this power but in addition they possess the power of uniting the Past with the Future by means of the Present. "Because this capacity for binding time, under a law of every increasing amelioration, is *peculiar* to man

[5] "A Lesson From History—Lest We Forget." Charles E. Munroe, *Ind. Eng. Chem.*, *14*, 75.

or is at all events his in an incomparable degree, the class of human beings is to be conceived and scientifically defined to be the Time-binding class of life. We have here . . . a new dimension, a new type, of life—life-in-Time. Animals are binders of space; man is a time-binder, . . . Such then is the new conception of man—the conception of a being whose character and appropriate dignity consist in his peculiar capacity or power for binding time . . . Though we human beings are indeed not a species of animal, we are *natural* beings; it is as natural for us to bind time as it is natural for fishes to swim or birds to fly."

"That fact is fundamental. Another one, also fundamental, is this: time-binding power—the characteristic of humanity—is not an effect of civilization but is its cause; it is not civilized energy, it is the energy that *civilizes;* it is not produced by wealth, whether material or spiritual, but is the source and creator of both. Inasmuch as time-binding is the characteristic of humanity, to study and understand man is to study and understand the nature of his time-binding energies; the laws of human nature are the natural laws of these energies; to discover these laws is a task of supreme importance for it is evident that upon the natural laws of time-binding must be based the future science and art of human life and human welfare."

"One of the laws we already know . . . is the natural law of progress in time-binding, or civilization-building. Let us glance at it. Each generation of (say) beavers begins where the preceding generation began; that is a law for animals—there is no advancement, no time-binding—a beaver dam is a beaver dam. Contrast this with human life. Man invents and discovers and creates. An invention leads to new inventions, each discovery to new discoveries, each creation to new creations; invention breeds invention, science begets science, the children of knowledge and art and wisdom produce their kind in larger and larger families; each generation begins, not where its predecessor began, but where it ended; things done become instruments for the doing of better things; the Past survives in the living achievements of the dead; the body of these achievements—invention, science, art, wisdom—is the living capital of the ever-passing Present, inherited to be held in trust for enlargement and for transmission to Future man; the process is that of time-binding; Past and Future are thus united in one eternal Now owning a law of perpetual growth and continual progress."

May we not justly hold that this new concept offers the greatest of all reasons for studying chemistry, namely, to be of the number who shall pass on to the coming generations that which was their heritage with much added thereto?

ABSTRACTED AND REPRINTED ARTICLES

ORIGINAL COMMUNICATIONS.

Address Delivered by the President, Daniel B. Smith, Before the Philadelphia College of Pharmacy, at the Annual Commencement of the College, September 24, 1829.

It would ill become me, upon the present occasion, and before the present assembly, to attempt by any ambitious effort of rhetoric to captivate or amuse the audience. I cannot forget that we are all plain and practical men of business—assembled here for supporting an institution, the origin and end of which is our own pecuniary advantage. It is true that our profession or business is of a very mixed character—that while on the one hand, we are mere shopkeepers and manufacturers, we are, on the other, compelled to pursue a course of study, and to acquire an extent of information, scarcely less scientific and diversified than those of the physician. There is not indeed any business or trade in the community so nearly allied to the learned profession, and for a fair reputation in which a greater degree of probity and intelligence is required by public opinion. The merchandise in which we traffic is brought from every region of the globe, and consists of so great a variety of the productions of the animal, the vegetable, and the mineral kingdoms, that to be a skilful druggist is to be not merely a well informed merchant, but a learned naturalist. The daily experience, I will not say of the laboratory, but of the shop and the counter, is a continual application of chemical principles, without a knowledge of which we should be ever groping in the dark. Even where these qualifications are possessed, there must be the still higher attainment of strict integrity and of an earnest devotion to the profession, in order to secure that implicit confidence, on the part of the public, which is the most cheering reward of an honest and skilful apothecary.

If then we are seeking to promote our own private advantage in the establishment of this college, we are seeking to promote it by liberal and patriotic means, the success of which will advance the public welfare in a far greater and more lasting degree than the whole amount of our own individual profit; for the latter will per-

ish with us or our children, and the former I trust will go on increasing with the progress of philosophy and society. The object of this institution is the improvement of the theory and practice of pharmacy, not merely in books and treatises but on the broadest and most extensive scale at the laboratory and the counter. For this purpose we are providing means for educating our apprentices in all the learning of the age which has a bearing upon their profession, and for imbuing them with habits of the strictest method. The inevitable effect of this system will be, that we, who are now the older members of the college, must apply ourselves again to our studies, must keep pace also with the improvements of science, or we shall see ourselves outstripped in the career by the boys whom we have instructed. Most, and indeed I may say all of the founders of this institution were men who made no pretensions to accurate science or profound learning.

They had been taught the art of the apothecary as practised in this city—loosely and clumsily, I may now say, without any disparagement to ourselves. They felt the evils of being ignorant of scientific principles and of a deficient pharmacy, and they resolved to apply a remedy. It cannot be supposed that shrewd and enterprising men, such as first embarked in this undertaking, could be blind to the consequences of making their apprentices better apothecaries than themselves. They did perceive them, and met them with a public spirit and a disinterestedness which make me feel proud of my profession.

The benefits which were anticipated from the formation of the College of Pharmacy were of a remote and general kind. It was not then supposed that the reaction of the spirit of improvement could sensibly affect the practice of pharmacy until after a lapse of many years, and to these remote advantages they sacrificed those which many of them possessed as leading druggists, by placing themselves on a level with all who chose to accede to the terms on which the college was established. Their expectations were more than realized, and all who are acquainted with the medical statistics of this city will bear witness to the assertion that the practice of pharmacy has already, since the commencement of our institution, experienced a most salutary and remarkable improvement.

The mark at which we are aiming is however much above the standard of any present attainment. Before we can assume to compete with the kindred institutions of the old world, our system of

scientific instruction must be extended to other branches of natural history, and rendered more thorough and minute in those which are already taught; and the candidates for the honours of the college must undergo a close and probing examination before they are admitted to practice under its diploma. Our members must be willing to subject the contents of their shops to periodical scrutiny by impartial and competent judges; the college must exercise a vigilant police over the market for drugs, and over the weights and measures used in the administration of medicines. We must possess a Pharmacopœia adapted to the condition of this country, and founded upon strict analysis and experiment, in which, without blindly following the formulæ of any foreign college, we may avail ourselves of the lights which are scattered throughout all.

In proportion as we attain these objects shall we realize the great advantages which it is in the power of this college to confer. And it will happen in this, as in all similar cases, that the advantage of it will not be confined to ourselves, but many other classes in society—nay, the whole community will be in a greater or less degree, either directly or indirectly, profited by the improvement and prosperity of our science.

In thus looking to the future with hope, we are naturally led to look back and abroad for instruction, and it may not be an unprofitable task to mark the progress and present practice of pharmacy in foreign countries.

Without exploring the history of ancient nations for the vague and unsatisfactory notices that may be gleaned from their pages, it will be more instructive to mark the first rise of our profession at the restoration of letters in Europe. The business of the apothecary as a separate profession is said first to have existed among the Arabian in the eleventh century. From them the practice spread into Spain and Italy, and following the path of medicine and letters, to Germany, France and England. The language of one of the first European edicts for their establishment, that issued by the emperor Frederick II. for the kingdom of Naples, furnishes a curious example of the change effected by time in the signification of words. This edict provides that the *confectioners* should take oath to keep by them fresh and sufficient drugs, and to make up medicines exactly according to the prescriptions of physicians; it also fixes a price at which the *stationers* may vend the medicines thus prepared. An *apothecary* at that period was simply one who kept an *apotheca* or store or warehouse.

With the discovery of the art of distillation and the introduction of chemical medicines the importance and dignity of the apothecary increased. In many places, and particularly in the opulent cities of Germany, the apothecaries' shops were established at the public expense, and belonged to the magistrates. At the courts of Germany it was very common for the consorts and sisters of the princes to establish and conduct them for the relief of the poor. From these causes in part it has happened that the apothecary has ranked higher in that country than elsewhere. In many places he was a functionary of the government, attached to the court, and receiving a salary. In all he was protected from competition by being one of a number limited by law, and the path to wealth and distinction was thus secured to him. About the close of the fifteenth century, that spirit-stirring era in the annals of our race, the rising importance of the science of medical chemistry appears to have attracted the attention of the petty sovereigns of Europe. It was at this period that Paracelsus introduced the use of mercury, and after filling Europe with his fame, died in the prime of life with a bottle of his celebrated panacea in his pocket! The earliest professorship of chemistry established in Europe was that of Basil, which was first filled by this insolent and intoxicated enthusiast. At Augsburg there were apothecaries' shops so early as the thirteenth and fourteenth centuries. In the middle of the fifteenth century a salary was paid by the city to the persons who followed that occupation, and in the year 1502 a price was set upon all their medicines; all others were forbidden to deal in them; and their shops were ordered to be inspected. These regulations form the basis of the German police of medicine at the present day. The apothecaries are limited in most of the towns to a certain number, so that the ownership of a licensed shop is of great value, and the strictest vigilance is used in the inspection and administration of medicines.

A lively French writer gives the following sketch of the condition of the apothecary at Vienna, which may be taken as a fair specimen of his situation throughout the large cities of Germany. The number of Pharmaceutists in Vienna is limited, and in their shops the manual labour is distributed, so that one pupil makes all the pills, another all the mixtures, and this alternately for a month or quarter. The prescriptions are copied in a book to which the physician or the patient may at all times refer. The German apothecaries never contend with each other by underselling. They

enjoy a consideration founded upon that which they pay to each other; their establishments are a fixed property, and there is neither rivalry nor collusion among them. Secure of realizing a fortune by their business, they introduce a rigorous method into all its details. Less splendid in the exterior of their shops than the French; they have more true solidity in the arrangements within, and their medicines are recommended by the excellence of their preparation. The German apothecaries have prevented their business from becoming purely mercantile. They have commanded respect from others by paying it themselves to their profession. In the midst of wars and disorders the German apothecaries have profited by the discoveries and improvements of other nations, and have remodeled their dispensatories upon the most scientific principles. More copious than the English, and less prolix and complicated than the French, their pharmacy has adopted the best parts of the Pharmacopœias of London and Paris, and is intermediate between these two systems. The Germans accordingly furnish apothecaries to many of the neighbouring countries. They enjoy the monopoly of the business in Prussia, and there are none but German apothecaries in Moscow and St. Petersburg.

In the latter city an apothecary dare not make up a prescription of any practitioner whose name is not in the printed lists of physicians; nor can he venture to sell a drug, however small in quantity or insignificant in quality, without a prescription regularly signed; and every thing sent from his shop must be wrapped in a sealed packet.

The practice of pharmacy in England has remained unfettered by any other legal restraints than those which restrict other branches of industry in that kingdom. The physician originally prepared and furnished the medicines for his own patients, but by degrees those who prepared the medicines became a separate class of men. The apothecary in England was at that time precisely what he is in America at this day—a retailer and compounder of drugs. The temptation to prescribe for his customers appears to have been too strong to be resisted, and the apothecary lapsed by degrees into the practising physician. The regularly educated resisted this innovation as long as it was in their power, and the controversy on the subject was both virulent and ludicrous. The apothecary however triumphed, although he rendered homage to the physician as his superior. He became the ordinary practitioner in families, charg-

ing not for his advice but for his attendance and medicines, and yielding his post to the physician in cases of emergency. The alliance is more profitable to the craft than to the patient, for it has given rise to such an immoderate use of medicines among the English as has become proverbial, and justifies in degree the sarcasm of a French writer, who says that they carry their idolatry to medicines to such a pitch that they bear about them wherever they go their favourite salts and digestives.

In London, and all the cities and towns of Great Britain, apothecaries, or as they there style themselves, druggists, are now to be found who confine themselves to selling medicines, and who do not prescribe. Within the last forty years this class of tradesmen has greatly increased, and the principal shops of the kind in London are perhaps among the best regulated in the world. In one especially—the most celebrated in that great emporium—the system of business is so perfect as to excite admiration. The shop is situated in a narrow court, the only access to which is through an arched alley. Before any article is allowed to be sold it is examined and approved, and if a chemical preparation, is tested by one of the partners, and no medicine is permitted to pass out of the shop but of the finest quality. Each clerk has his particular station at the counter, and the requisites of business about him, his own money drawer and medicine bottles, scales, measures and papers, for the utmost cleanliness of all which he is accountable. He sets down all the money he receives, as it is paid in, and keeps his own cash account. No conversation above a whisper is allowed except on business.

A minute account is kept, and an investigation made at regular periods by one of the proprietors, into all the incidents of the shop, the errors in putting up medicines, or in the cash accounts, and of the manner in which the rules of the shop, which embrace all the minutiæ of cleanliness and method, have been observed. Such strict system and accuracy may be difficult to enforce, and may seem like a useless waste of time. But there is no such thing as too much system or accuracy in the business of an apothecary; and the great reputation of the shop to which I allude is a proof that it is profitable as well as creditable. A thousand guineas, it is said, have been offered to the proprietors as a fee for an apprentice.

The history of pharmacy in France however presents more materials for our instruction than in any other country of Europe.

The trade of the apothecary had its origin in that kingdom in the thirteenth or fourteenth century, and the apothecaries were for a long time the menials of the physician. The oath which the latter imposed upon the former before they were allowed to open shop is a curious example of the mental slavery of the times. The apothecary bound himself by the most solemn sanctions of that superstitious age, to give no medicine whatever without the counsel of some learned doctor, to do nothing rashly without *advice,* never to speak disrespectfully of the ancient doctors, but to honour and render service to them, and to do every thing for the honour, glory, and majesty of medicine. Another part of his oath is as little to the credit of his morals as that which I have quoted is to his independence. He bound himself not to administer poison even to his greatest enemies, and never to substitute one medicine for another without the advice of a person wiser than himself.

In a country where such an oath could have been exacted, and men were found servile enough to take it, we cannot wonder at the contempt into which both the physician and the apothecary sunk, and with which even the overwhelming satire of Moliere could not have covered them, had there not been as much truth as wit in his exquisite caricatures.

The profession of the apothecary has however long since recovered its respectability in France, and has been elevated and protected by a code of laws which deserves in most respects to be universally copied.

Many wholesome regulations were enacted under the Bourbons about the middle of the last century; but the laws which created and now govern the schools of pharmacy were the offspring of the revolution. The number of physicians who were members of the national assembly will account perhaps for the great attention which was paid by that body to the interests of the healing art; but it is nevertheless one of the extraordinary features of that period of violence and bloodshed, that neither its foreign nor civil wars, desperate and ferocious as they were, interrupted to any extent the progress of science and the arts.

The French law regulating the sale and dispensation of medicines establishes three schools of pharmacy—one at Paris, another at Strasburg, and a third at Montpelier. Each of these schools is obliged to open at least four courses of experimental lectures—one

on botany, one on the natural history of medicines, and the other two on practical pharmacy and chemistry.

The pharmaceutists in those cities are compelled to enter at the school the name, age and other circumstances of their apprentices, who are all obliged to attend the lectures. An apprenticeship of eight years is required before a person is allowed to open a shop, except he has attended three courses of lectures in one of the schools, when only an apprenticeship of six years is exacted. We may suppose that the course of instruction in these schools is both learned and extenive from the length of time it occupies, which is five months, and from the strict scrutiny which is exercised over the attendance of the pupils. A roll of their attendance is kept, and the professor at the end of the course delivers to each one who has attended a certificate thereof. An absence without a legitimate excuse from six lectures will deprive a pupil of this reward. A prize is annually delivered at the expiration of the course for the best essay on any of the sciences taught in the schools.

When a pupil wishes to become a licentiate, he is required to produce the certificates of the school where he has studied and of the pharmaceutists with whom he has served his time, as well as an attestation of his moral conduct, signed by two resident citizens and two authorised pharmaceutists. He must also produce a certified copy of the register of his birth, to prove that he has completed his twenty-fifth year. If the director and professors of the school are satisfied with these documents, they appoint a day for the first examination. The student must undergo three public examinations, the interval between each of which must be at least a month. One of these is on the principles of the art; another on botany and the natural history of the materia medica; the third examination is on the practice of pharmacy, and continues for four days. It consists of at least nine chemical or pharmaceutical processes, performed by the candidate in the presence of the examiners, to whom he must describe the materials, the operation and the results, and explain the rationale of the process. He must receive the votes of two-thirds of his examiners before obtaining his diploma.

In those places where there is no school of pharmacy established, the examinations are conducted in the same manner by a jury composed of physicians and pharmaceutists, and no person is allowed to practice pharmacy unless licensed by a jury, or by one of the established schools. The licentiates of the schools can exer-

cise their profession in all parts of the kingdom; those of the juries are restricted to the department in which they have been examined. No pharmaceutist is permitted to sell any secret medicine. At Paris, Strasburg and Montpelier an annual inspection of the shops and warehouses of the pharmaceutists and druggists is performed by a board consisting of two professors in the medical school, the members of the school of pharmacy and a commissary of the police. All deteriorated or badly prepared drugs are seized by the commissary, and the person in whose shop they are found is liable to a fine of one hundred livres and an imprisonment not exceeding six months. These annual visits of inspection are paid in other places by the juries who examine the candidates. The laws regulating the sale of poisons are exceedingly severe, and the list of forbidden medicines extends considerably beyond the usual limits of caution in this country. It includes not only arsenic, corrosive sublimate, and lunar caustic, but the mineral acids, several preparations of zinc, antimony and copper, and caustic potash. All these substances are required to be kept in secure and separate apartments, of which the master of the shop alone keeps the key. They are to be sold to none but a known and resident person, under a penalty of three thousand francs; and all purchasers must write their names and residence, the quantity and nature of the poisonous drugs they have bought, and the purposes for which they are wanted, in a register open to the inspection of the police, under the same penalty.

There is another branch of the public law of France on this subject which deserves our particular attention, for it strikes at the root of a practice of great extent and great mischief in our own country; I allude to the encouragement given by our druggists to ignorant, idle, and drunken collectors of herbs and roots. No person is allowed to follow the business of an herborist, as it is there called, without undergoing an examination into his competency before the same bodies which examine the pharmaceutists. This examination extends to his knowledge of medicinal plants and of the precautions necessary to their collection and preservation. A certificate of examination is furnished to the successful candidate, and he is subjected to the annual visits of inspectors in the same manner as the pharmaceutists.

Notwithstanding the wisdom of many of these regulations, it appears that in the enforcement of the law many abuses have crept in. The professors in the schools of pharmacy, in order to aug-

ment their fees, have been very lax in their examinations, and the juries have been still more careless of the qualifications of candidates. The consequence has been that the country is overrun with ignorant and unqualified licentiates, who blend other branches ot industry with the sale of medicines.

These abuses attracted the attention of the society of pharmaceutists of Paris, which addressed a memorial in the year 1817 to the chamber of deputies on this subject. In this memoir they speak with becoming pride of the high character of their profession. "The knowledge" say they "which pharmacy requires, without being as extensive, is in part the same as that which is necessary to the physician. It is as various, and is sufficiently useful to entitle him who possesses it to the particular protection of government and to general respect. The pharmaceutists enroll in their number men of distinguished learning, who belong to the most celebrated academies, skilful professors who fill the chairs of chemistry and natural history, writers whose works are sought for in France and abroad, respectable citizens whose public services have been rewarded by honours, titles and decorations." It is only to enumerate the names of Parmentier, Vauquelin, Deyeux, Henri, Planche, Pelletier, Virey, Boullay and Robiquet, to vindicate the warmth of this honest eulogium.

In speaking of the abuses which had crept in through the causes to which I have alluded, they observe that "the number of established pharmaceutists soon exceeded everywhere the wants of the inhabitants. This disproportion between the shops and the population was equally fatal to pharmacy and the public. When the confidence of physicians and patients is divided between too great a number of shops, does it not offer temptations to the least successful, which are at the least of great inconvenience to those who trust for their cure to the faithful execution of the prescriptions of the physician? Whatever may be the probity of a pharmaceutist, his pecuniary means, his credit and his sales always influence the proper choice, preservation and renewal of the medicines he employs. This profession bears no resemblance to those in which the prosperity of the trader is useful only to himself. The prosperity of the pharmaceutist is a guarantee to the public almost equal to that which is afforded by his learning. This guarantee disappears if the multiplicity of shops places a part of them in a precarious situation.

"The medical juries" say they "have peopled the country and

the small towns with apothecaries destitute of all the requisite learning and science, whose knowledge of their business was limited to a few manual operations.

"The want of discipline and inspection opens the door to many other abuses. Perfumers, confectioners and distillers undertake to sell medicines; and to crown these disorders a cloud of charlatans, without title, without learning, and without shame, have established themselves in the towns and villages, cover the walls with their bills, and distribute them on the bridges, the wharves and public walls. These men are neither physicians, surgeons nor pharmaceutists; yet they practice physic, surgery and pharmacy; they inundate the country with their nostrums; and the public journals which are hired for the purpose, daily make a boast of these pretended specifics."

Who does not recognise in this sketch of the condition of pharmacy in France many of the evils which mark in a far higher degree its state in our own country—the want of scientific skill and of competent qualifications—and the evils of unrestricted competition?

The pharmaceutic code of Prussia has provided against the abuses of which the French pharmaceutists complain, by requiring and carrying into effect a far more rigorous examination of the candidates. The laws of that kingdom require that a candidate for examination must have served a regular apprenticeship of five years, or have been employed for three full years as an assistant in a licensed shop, and at the completion of either period must have attended two full courses of lectures on botany, chemistry, natural history, pharmacy and medical jurisprudence. The board of examiners is composed of two chemists and naturalists and two sientific and practical apothecaries, who are paid by the government, and have had no part in the instruction of the pupil. The candidate is first obliged to translate passages taken at random from the Prussian Pharmacopæia, to satisfy the board of his skill in the Latin language. He must then write a Latin theme on two subjects of chemistry or medical jurisprudence, the titles of which are drawn by lot from an urn. This theme must be written in eight hours, in the presence of the examiners, without the aid of books, assistants or extracts. If he pass this ordeal, two difficult subjects of pharmaceutic or analytic chemistry are given to him, upon which he is obliged to write a theme at his own dwelling, with the aid of

books, in order to prove that he has received the highest scientific chemical education. He then draws by lot two chemical or pharmaceutic substances, either natural or artificial, and is allowed eight days, at the end of which time he must have made a complete analysis of them, and written down the results of his experiments. He is also obliged to analyse the contents of the purposely poisoned stomach of an animal, and to write a juridico chemical paper thereon. Not satisfied with so close a scrutiny, which would deter any apothecary in this country from soliciting an examination, the candidate is then required to draw by lot the names of two pharmaceutic compounds of difficult preparation, which he is obliged to prepare in the presence of the committee extemporaneously.

Specimens, fresh and dry, of official plants, ten samples of drugs, and several chemical preparations are then placed before him, which he must name at sight. He must then give accurate scientific descriptions of the plants and of their uses, must describe the origin, properties, and adulteration of the drugs, and the chemical elements, mode of preparation, and usual adulterations of the chemicals, and the means of testing their purity.

The examiners are obliged to be present through all these trials, and to keep accurate minutes of their proceedings, and of the success or failure of each attempt. If they approve of the candidate by a majority of votes he is admitted to the public examination, at which he must answer questions in chemistry, natural history and medical jurisprudence; after which, if he is still further approved of, he is recommended to the minister of the interior, who gives him a license to practice his art.

From this brief and imperfect sketch of the laws regulating the practice of pharmacy abroad, let us turn to the condition of the art in our own country. How great is the contrast! An entire absence of legislative enactments, and with the solitary exception of this city, an almost entire want of professional emulation and of scientific instruction. This state of things has arisen from the freedom of our institutions, which places no restraint whatever upon private enterprise, and from the recent settlement of the country, which still checks that subdivision of labour that is perhaps necessary to the highest degree of excellence in the arts and sciences. It is but a few years comparatively since the business of the apothecary was separated from that of the wholesale druggist and the dealer in paints and dye stuffs. Not thirty years ago almost the only apothecary's shop in Philadelphia, where the physician was sure of obtain-

ing the latest foreign preparations, of having his medicines and prescriptions prepared under the eye of the master, and with competent pharmaceutic skill, or in which a strict system of accountability was carried through the details of the shop, was that of the late Charles Marshall. The cause of his success in business was his strict integrity, his scrupulous accuracy, and his patient attention. As the first president of this college he is entitled to our respect and remembrance. He was one of its warm supporters, and though too far advanced in years to take an active part in its proceedings, the interest which he felt in its welfare continued to the close of his long and useful life.

It is now about ten years since an accidental circumstance first impressed the apothecaries and druggists of Philadelphia with the necessity of exercising some supervision over the sale of medicines. A case of opium was purchased in New York by one of our principal dealers, which was said to be Persian opium, and which was soon discovered to be a fraudulent preparation. A meeting of the trade was held and a committee appointed to investigate the history and nature of the opium, which they did, and published their report in the daily papers. The fraudulent drug was immediately withdrawn from the market, and no similar attempt at imposition has since come to the knowledge of the public. From that time the necessity of forming an association of druggists became a favourite subject of discussion with many in the trade. In the year 1821 the trustees of the University of Pennsylvania, at the suggestion principally of the professor of materia medica, made provision for conferring the degree of Master of Pharmacy on those apothecaries who should be deemed most competent to the business, and for the establishment of lectures on pharmacy, the examination of candidates, and the admission of them to practice under the sanction of the medical school of the university. This arrangement was defective in many respects; it would have created a control over the business of the apothecary without any equivalent compensation such as our college has rendered. The druggists therefore resolved to take into their own hands that supervision and improvement of their trade which was acknowledged on all hands to be expedient. A meeting was held on the 13th of February, 1821, at which the principal druggists attended, when it was resolved to form a college of apothecaries for the purposes of regularly instructing apprentices in the scientific parts of the business and of checking the

prevalent abuses. The college was incorporated in the year 1822, by the title of the Philadelphia College of Pharmacy, and its career from that day to the present has been one of steady and active exertion for the improvement of our business. The extent of these exertions and of the advantages which have flowed from them are not now appreciated, for they consist in great measure in clearing the ground and laying the foundation for future labours. The first efforts of the college were directed to the formation of a school of Pharmacy. The regulations which it has adopted in relation to this, are perhaps all that the present state of our business will admit. The members are restricted from taking apprentices for a shorter period than four years, and each apprentice is required to attend two full courses of lectures, one on materia medica and pharmacy, and the other on chemistry. At the expiration of his apprenticeship he may, provided these conditions have been fulfilled, become a candidate for the diploma of the college, and must submit to an examination before a committee, consisting of the professors and three members appointed by the college. Our diploma is of course but an honorary distinction, that confers no privileges or advantages beyond those which public opinion accords to the well instructed and intelligent. It bestows no title, for it was the design of the college to avoid any name which may hereafter acquire a peculiar meaning, and become the designation of a new class analogous to the English apothecary. In attempting to avoid this danger, it has committed what may perhaps be esteemed a blunder, by establishing a distinction without giving to it a specific name, and simply declaring that the successful candidate is a graduate in the college. Those who have already passed their examination may be disposed to smile at the contrast between the trial to which they have been subjected and the severe ordeal of the Prussian code. It is true that we require as yet no proof of skill in analytic chemistry, but the questions of the examiners extend to all the branches of chemistry, pharmacy and natural history which are taught in the lectures, as well as to the more practical details of the business of an apothecary. To answer these questions with the promptness and accuracy that have in most cases been done, implies an acquaintance with the theory and practice of our art highly creditable to the candidates, and when contrasted with the state of things but a few years past, full of promise for the future. A taste for chemical pursuits has been awakened in our apprentices, who have formed themselves into a chemical society,

which meets in this hall under the auspices, we may say, of the college. We already perceive the beneficial effects of thus arousing their ambition in their increased attention to our interests and their love of the business, and I speak from experience when I say that the direct and immediate influence of the school of pharmacy has been to enhance to the master the value of his apprentices. This happy result is no doubt owing in great measure to the personal character and influence of the professors whom it has been the good fortune of the college to secure.

I would not willingly offend against the decorum of modesty in speaking of those who are now present, but it must be acknowledged that if the college has been enabled thus to persevere in its work of reformation through good and evil report, and amidst discouragements of various kinds, it has owed much of the strength which it has shown to the zeal, to the learning and the perseverance —to the attractive, yet solid and practical lectures, and to the many amiable and excellent qualities of Drs. Wood, Jackson and Ellis.

When the improvements which are now contemplated shall be made, and a hall, fitted up with every convenience, not merely for lecturing, but for teaching practical analytic chemistry, shall be built, we shall then increase our library and cabinet, and widen and deepen our course of instruction; and we may then hope by degrees to render the title of a Philadelphia apothecary but another name for a profound chemist and naturalist, and thus place our business where it ought to be, in the rank of the liberal professions.

Another department of the institution is the inspection which it professes to bestow upon the market for drugs and chemical preparations. Its influence in this respect has hitherto been of an indirect nature, although even as such it has been very considerable, for the general emulation which the establishment of the college has excited, has produced a scrutiny in the choice of medicines, and a care in their proper preservation, which already influence the market. It is by no means so easy as it was formerly to sell an inferior or sophisticated article; and higher prices are paid for medicines than could be obtained before the college was founded. A single instance will show the force of this observation. Twenty years ago almost the only kind of cinchona that was retailed in this city was the inferior variety brought from the Spanish main, and known by the name of Carthagena bark, which was only worth from ten to twenty-five cents per pound, and would have been burned by the

public officers had it been sent to Europe. At the present time no respectable apothecary would offer bark of such a quality to his customers. Similar remarks will apply to many other drugs, and to almost the whole catalogue of chemicals. It is only recently that it has been esteemed essential to procure the mineral acids, ammonia, alcohol, and the ethers, of standard specific gravities, of strict purity, or to prepare the officinal formulæ by the officinal weights and measures. A spirit of accurate examination into the qualities of medicines, of honourable emulation to excel in the whole arrangement and ordering of our shops, has taken place of this sordid indifference, and is co-operating with the influence of the college to produce an entire change in the practice of pharmacy in this city. The greatest discovery which has ever been made in pharmaceutic chemistry—that of the new vegetable alkalies—and of the facility which the active principles of our most valuable medicines can thus be insulated, has been made at a period singularly happy in regard to its influence upon this spirit of improvement, for it has thrown open to the active and awakening curiosity of our pupils a new field of investigation, in which the harvest of discovery that awaits the chemist will probably be more rich and copious than in any other department of chemistry.

It is now the third year since the system organised for granting our diploma has been carried into effect, and during each of those years there have been successful candidates for its honours. The trustees of the college have announced, in the regular course of their duty, that at the close of the last session of the school of pharmacy Charles Pleasants, William R. Fisher, Joseph Head Brook, Joseph Scattergood, John Allen, Franklin R. Smith and Robeson Moore, having completed the regular term of apprenticeship, and attended the requisite courses of lectures; having also each of them produced a written theme on some subjects of pharmacy or chemistry, and been questioned by the examining committee upon their attainments and qualifications, have been declared worthy of receiving the diploma of the college.

It is now my pleasing duty, in conformity with the directions of the college, to deliver to you this testimonial of your industry and acquirements. You will receive it, young men, I trust, in the spirit with which it is granted; not merely as a tribute of praise to that industry and docility which become the period of youth, but as an earnest of your future acquirements, and of the distinction which it may be in your power, by your learning and

good conduct, to confer back upon the institution which thus honours you. You are entering upon the stage of life with peculiar advantages, which may influence the whole course and destiny of it, if you improve them as they deserve. The business to which you have devoted yourselves, is one that blends the humble offices of a shopkeeper, with the studies and researches of the scholar, so as to elevate and ennoble the one and to give a practical and useful character to the learning of the other. It is a business in which the strictest method, attention, patience and economy are indispensable for success; for it is a business the beginnings of which are small, the increases thereof slow, although the end be safe and certain. You must always bear in mind that your reputation will be your capital in trade, and that it is reputation not merely of professional eminence, but in the highest and most comprehensive sense of the word, as a skilful apothecary—as a careful, prudent and steady citizen—as an honest, humane and upright man—which constitutes this capital, and which it should be the chief study of your professional life to deserve. In the ordering of your shops you should practice the strictest accuracy and method. It is impossible for you to err in the extreme on this point, for the lives of your fellow citizens are in your hands. The reputation of the medical profession is dependent in most cases upon our fidelity in preparing their prescriptions—and a single error of carelessness or ignorance may deprive you at one blow of the rewards and the promises of all your past labours, and be the means of plunging a family into the greatest distress, and an unprepared fellow creature into eternity. The responsibilities of our profession are indeed serious, and the saying of the illustrious Cullen is not less true of the apothecary than the physician—that it is his first duty to fear God.

The uncertain course of human events will probably bear some of you to distant lands, and scatter you widely from each other and from your preceptors. Wherever and under whatever circumstances you exercise your profession, endeavour to bear in mind the circumstances of this evening. Consider them as a pledge rendered to your instructors, to the college of pharmacy, and to your fellow citizens, for your future honourable conduct, your professional integrity, and the lustre which it is in the power of every one of you by patient scientific research and investigation to shed upon that institution for which, wherever your lot may be cast, I trust you will always entertain feelings of lively gratitude and affection.

CHEMICAL ATTRACTION.*

By David Wilbur Horn.

Many solid compounds decompose yielding gaseous decomposition products, provided the temperature of the compounds is elevated sufficiently. Deville (1857) designated this process *dissociation.* A compound need not be a solid in order to exhibit such dissociation, and it has been suggested that a substance possibly need not be a compound in order to dissociate. Lockyer regarded it probable that the elements not recognizable in the sun's spectrum have been "*dissociated* by intense heat." It is stated that the hydrogen of the chromosphere is "too hot to burn," the temperature of the solar surface being above that of dissociation, *i. e.,* so high that all compounds of hydrogen would there be decomposed.

Confining attention to isolated exothermic compounds, it is a reasonably fair generalization that temperature and stability bear an inverse relation to each other. If it be postulated that stability is a measure of the chemical attraction by which the constituents of a compound are held together to form the compound, then (other things being equal) it is a reasonably fair generalization that relative temperatures of dissociation of comparable compounds bear a direct relation to the relative strengths of the chemical attraction, or, of the resultant of all the attractive and repulsive forces at work, within each of the compounds considered.

The problem suggested in this generalization is complicated, and it may be that our knowledge of chemical attraction and of heat is too meager to permit of its solution. In the matter of chemical attraction our knowledge has been advanced far enough along certain lines to permit of some ordinal arrangements of the acids. In the matter of heat, changes in amount and temperature are capable of exact quantitative statement.

To the general problem no novelty can attach. The works of Thomsen (1853 forward) and Berthelot (1865 forward) are generally familiar. In this connection, however, it is the writer's thought that in certain cases of dissociation there is a field for study of great interest and promise. What is offered in this paper has to do mainly with a method of attack. The experiments described are

*From *Transactions,* Wagner Free Institute of Science of Philadelphia, X, 1923.

all more or less preliminary and illustrative, rather than final, in character.

The equilibria that establish themselves when any solid compound undergoes thermal dissociation into another solid and a gas, may be represented diagrammatically by a curve similar in shape to the curve shown in Figure 1. For each temperature a certain and single-valued pressure is sooner or later established simultaneously with equilibrium. Similarly, the equilibria that establish themselves between a liquid and its vapor are equally well represented diagrammatically by the same curve.

The distinction between the phenomena within the system represented by the equation $CaCO_3 \rightleftarrows CaO + CO_2$, for example, and the phenomena within the system $\underset{\text{Liquid}}{H_2O} \rightleftarrows \underset{\text{Vapor}}{H_2O}$ must be regarded as conventional. It has been convenient to refer to the former as a *chemical change* and the latter as a *physical change*. For the present purposes this distinction is unnecessary and misleading. The facts as set forth by the common curve suggest a close analogy between these two kinds of processes, which is not contemplated when they are distinguished as *chemical* and *physical* respectively. This suggested analogy was much strengthened when Horstmann (1869) showed that dissociation may be dealt with (mathematically) in the same terms as vaporization. Not long afterward Willard Gibbs (1875-1878) demonstrated that this analogy must be regarded only as a special case under a perfectly general mathematical mode of treatment, rigidly applicable to all equilibria in heterogeneous systems. The potential usefulness to chemists of the point of view developed by Gibbs was pointed out by Roozeboom (1887) in a paper in which he arranged the dissociation-equilibria then known according to the number of components in each system and the number and character of the phases involved. The Phase Rule is a simple and useful expression of Gibb's great generalization.

Under the Phase Rule, which is ordinarily written $F = C + 2 - P$, both the systems exemplified by dissociating calcium carbonate and by evaporating water, respectively, are *monovariant*. In the systems like calcium carbonate, there are 2 components (here CaO and CO_2) and 3 phases (here solid $CaCO_3$, solid CaO and vapor CO_2); if these numbers are substituted for C and P respectively in the Phase Rule, the result is $F = 2 + 2 - 3 = 1$. In the systems like water, there is 1 component (here water) and 2 phases (here liquid water, and vapor water); if these numbers are substituted for

C and P respectively in the Phase Rule, the result is $F = 1 + 2 - 2 = 1$. When the degrees of freedom, F, in any system equals 1, it can exhibit only monovariance; for each temperature at equilibrium there will be one and only one pressure, and vice versa, no matter how complex the system may seem to be.

With the analogy between the two orders of monovariant systems in mind, there is justification for comparing the corresponding curves throughout their lengths. When any set of curves representing comparable dissociating systems are compared along a line of constant temperature, the systems arranged in order of the magnitude of the pressures within each at this common temperature will be thereby arranged in the order of their relative stabilities. The least stable system will exhibit the highest pressure, and vice versa. Also when any set of curves representing comparable dissociating system are compared along a line of constant pressure, then the systems arranged in order of the temperatures within each at this common pressure will be thereby arranged in the order of their relative stabilities. The least stable system will exhibit the lowest temperature, and vice versa. This idea the writer has presented previously (*Amer. Chem. Jour.*, 1908, *39*, 222), and has shown that by such comparisons among cuprammonium compounds he was led to an arrangement of the acids in an order that is substantially the same order as that previously arrived at (by Thomsen) through thermo-chemical considerations, and (by Ostwald) through considerations of volume.

With the analogy between the two orders of monovariant systems in mind, there is also justification for comparing or seeking to compare the phenomena represented at the termination of the curves. For water and for all other liquids that withstand decomposition and that have been studied, the graph for this monovariant system of the first order (that is, one-component system) reaches an end in the region of *critical phenomena*. A temperature, called the critical temperature, is ultimately reached above which it is impossible to obtain or to retain the liquid (Andrews, 1869). It is fair to say that at the critical temperature the resultant of all the forces of attraction and repulsion at work within the liquid reaches a value that if exceeded the exhibition of properties as a liquid is impossible no matter how great the concentration thereafter realized within the system. By analogy, the interesting suggestion arises that at the upper end of the dissociation curve a temperature may

be reached above which it will be impossible to obtain or to retain the compound that has been dissociating. This temperature would be the one at which the resultant of all of the forces of attraction and repulsion at work within the compound (by virtue of which it becomes and remains a compound) reaches a value which if exceeded becomes such that the properties of the compound can not be exhibited no matter how great the pressure (that is, concentration in the vapor phase) thereafter realized within the system. In so far as this analogy has value, it offers a mode of attack upon "chemical affinity" by which a numerical (quantitative) statement may be found within reach.

As already stated, what is offered in this paper is preliminary and illustrative, rather than final, in character, and it has to do mainly with the experimental method of attack. In the simplest case the apparatus need consist only of two concentric test-tubes; within the inner tube the dissociating solid is placed with a thermometer mounted with its bulb in this solid. The outer tube is used to furnish an insulating air-jacket. The inner tube connects with the space into which the vapor from the dissociation is to escape through a delivery tube or other outlet so arranged as to permit and to compel the escape of the gas at constant pressure. Upon immersing the apparatus in a thermostat at a temperature such as to produce dissociation, it will be noticed that the thermometer in the solid will register at first a rapid rise, then a gradual halt, and then a slight drop to a temperature that will be found to remain constant for an hour or more although it may be several degrees lower than the temperature of the thermostat. The readings on the thermometer are made at regular intervals of time (every half-minute or every minute) and the readings may be plotted as ordinates against the time intervals as abscissas. The appearance of such graphs was pointed out by the writer some time ago (*Amer. Chem. Jour.*, 1907, *37*, 619), and may be seen in Figure 2 in this paper.

Each of the constant temperatures realized in a properly conducted experiment may be taken as the abscissa of the point on the dissociation curve (such as that shown in Figure 1) of which the pressure fixed in the experiment is the ordinate. By fixing the pressure (ordinates) at different values in a series of experiments, upon the same dissociating substance, the corresponding temperatures (abscissas) may be learned; and the data for plotting the dis-

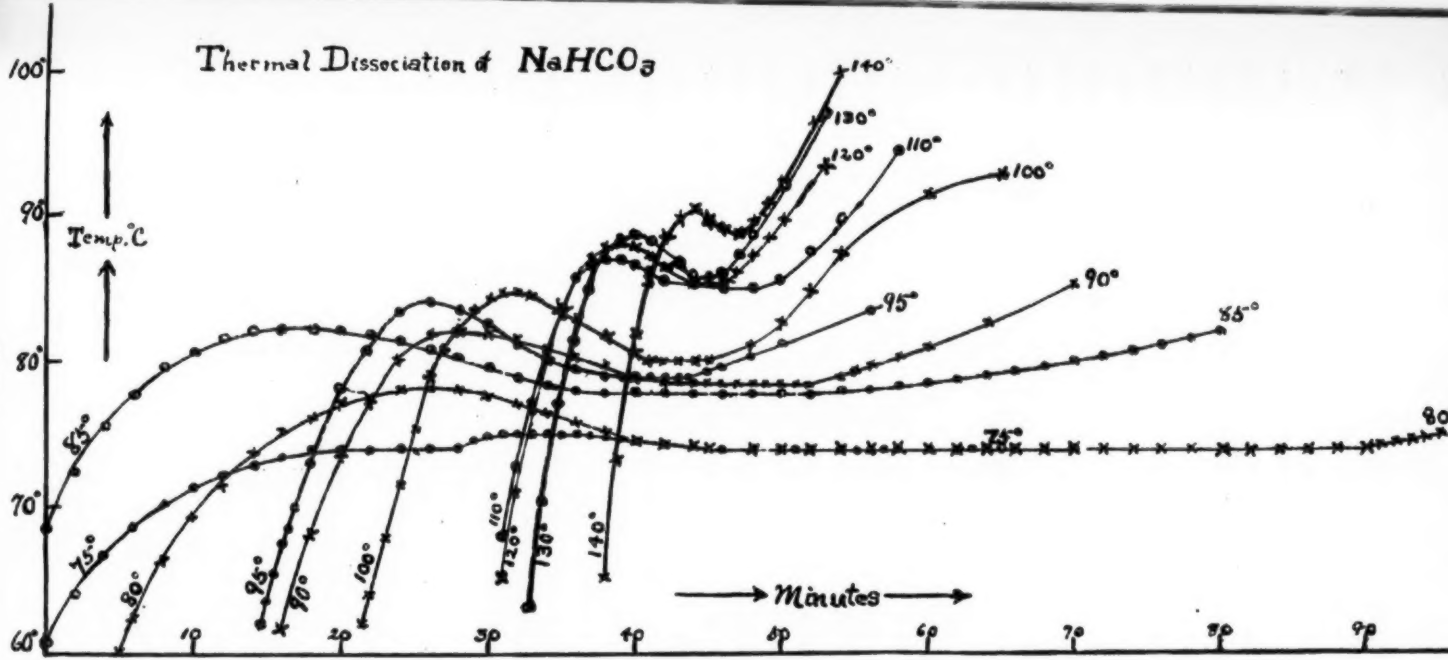

Figure 1.

TABLE I.

DISSOCIATION OF CUPRAMMONIUM NITRATE.

Pressure in cm. of mercury	*Temperature in degrees centigrade*	*Pressure in cm. of mercury*	*Temperature in degrees centigrade*
2.2	—36.5	75.7	+ 15.4
3.5	—36.0	75.8	+ 15.8
12.0	—16.3	97.4	+ 23.4
24.0	— 9.4	119.5	+ 29.3
38.7	— 2.5	146.0	+ 35.4
39.1	— 1.5	190.0	+ 43.4
54.9	+ 7.9	234.7	+ 50.5

sociation curve thus become available. Such a dissociation curve is shown in Figure 1, plotted upon the data set forth in Table 1. In obtaining these data I was assisted by Miss Ida V. McWilliams.

The plan of fixing the pressure and then learning by experiment the corresponding temperature of equilibrium is in flat contrast with the conventional procedure. Conventionally, the temperature is fixed and the pressure learned experimentally. The method discussed has such advantages as economy of time, much greater flexibility, and more convincing results. It may be called a *dynamic* method in contrast with the conventional *static* method, because the equilibrium temperature is learned while the compound is actually continuously dissociating; in the static method, the equilibrium pressure is attained and measured only after dissociation has reached equilibrium.

That the dynamic method will yield the same result as the static appears from experiments upon ammonia-silver chloride. Isambert's determinations by the static method of the dissociation pressures of ammonia-silver chloride at various temperatures show a value of 19.9 degrees C. at 1 atmosphere; Horstmann's independent determinations by the static method show 19.05 degrees. The dynamic method in my hands showed at 1 atmosphere pressure that a temperature of 19.4 degrees was attained and maintained constant by the system to within 0.2 degrees for upward of one hour. The period of constant temperature may be shortened or lengthened at will, at any pressure, by decreasing or increasing the mass of dissociating solid experimented upon.

No one familiar with the Phase Rule would venture to oppose this proposed method by urging that it is applicable only to the few ammonia-metal compounds studied. The following systems have been studied and found to exhibit the characteristic behavior to be expected under the Phase Rule of all monovariant systems consisting only of vapor and solid phases:

$$2\{AgCl.3NH_3\} \rightleftarrows \{2AgCl.3NH_3\} + 3NH_3$$
$$\{Na_2B_4O_7.10H_2O\} \rightleftarrows \{Na_2B_4O_7.5H_2O\} + 5H_2O$$
$$\{CuCl_2.2H_2O\} \rightleftarrows \{CuCl_2\} + 2H_2O$$
$$2NaHCO_3 \rightleftarrows Na_2CO_3 + H_2O + CO_2$$
$$\{Cu(NO_3)_2.6NH_3\} \rightleftarrows \{Cu(NO_3)_2.4NH_3\} + 2NH_3$$

The data for the cuprammonium nitrate system are given in Table 1 and Figure 1. The sodium hydrogen carbonate system has been studied differently with results set forth in Figure 2.

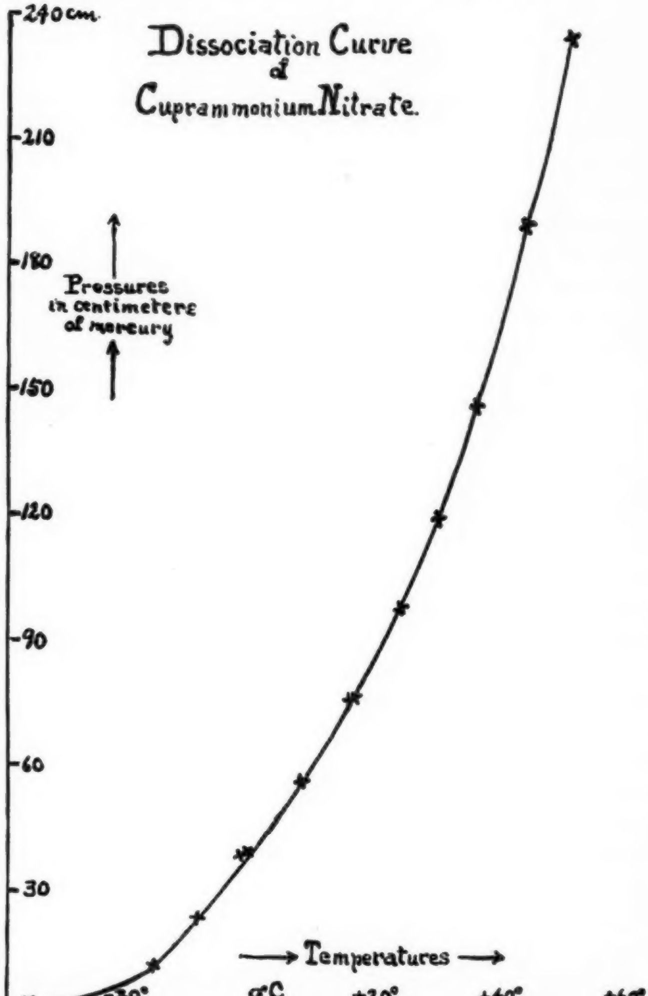

Figure 2.

The general course of a time-temperature curve in a successful experiment is shown in Figure 2 by the grah marked 80 degrees. The phenomena to be observed in a dissociating system whose

equilibrium is disturbed by some external influence, such as heat at a higher temperature in my experiments, can in general be predicted by what is commonly called the Theorem of Le Chatelier, which may be stated (Ostwald) as follows: "If a system in equilibrium is subjected to a constraint by which the equilibrium is shifted, a reaction takes place which opposes the constraint. . . ." The humps to be observed in the graphs in Figure 2 which give to each an S-shaped appearance, I have thus far assumed to represent a phenomenon of *continuity* (James Thomson, 1871).

These dissociating systems seem to differ from such systems as those composed of melting solids or boiling liquid in that the velocity at which the change can occur is less. One cannot overheat a melting solid, perhaps, or a boiling liquid (unless the other phase be absent), but one can overheat a dissociating solid. A moment's consideration of the well-known case of *a*-sulphur and *B*-sulphur will serve to show that such slowness is to be expected in change in solids. If *a*-sulphur is heated slowly enough, it will pass at 96 degrees to *B*-sulphur, and then only will its temperature rise higher than this transition point. But if it is heated rapidly, its temperature will rise to 115 degrees at which the *a*-sulphur will melt. Failure to recognize the existence of a finite rate of transition may lead to overheating and to misinterpretation of the minimum temperature maintained within the system.

The experiments made upon sodium hydrogen carbonate illustrate this point. In obtaining these data I was assisted by Mr. Charles E. Gulezian. The temperatures written at the ends of each curve are the temperatures of the thermostat during each experiment.

The transition temperature of the system $2NaHCO_3 \rightleftarrows Na_2CO_3 + H_2O + CO_2$ at 2.5 cm. pressure is approximately 74 degrees C. Even when the system is overheated excessively, as when the thermostat temperature was set at 140 degrees, the system still shows the behavior predictable by the Theorem of Le Chatelier, although the transition-velocity is too low to permit of the realization of the true transition temperature for the fixed pressure. As the degree of overheating is reduced by lowering the temperature of the thermostat, the behavior of the system approaches more and more closely to normal. If the reader will study these curves, he will see that the minimum temperature and the maximum duration of constancy are approached as the thermostat-temperature comes nearer

to the transition temperature. The general rule for procedure would seem to follow, namely, set the thermostat temperature at a few degrees in excess of the supposed transition temperature; the difference between the two should be such that the system exhibits the phenomena of *continuity* to an extent greater than could be accounted for by the experimental error.

If one transition-point at a given pressure is established, the general procedure thereafter is less time-consuming. And when a few points on the dissociation curve are known, its slope may be estimated closely enough to guide the further experiments.

The phenomena that I am dealing with are undoubtedly phenomena confined to the surface of the solid and regions contiguous thereto. Only at the surface of the solid where contacts with the vapor phase (and the other solid phase) occur can an equilibrium set up. The end of the period of constant temperature on a time-temperature curve such as the curve for $NaHCO_3$ marked 80 degrees does not therefore correspond to complete decomposition of the $NaHCO_3$ present. It corresponds to a condition in which so much of the $NaHCO_3$ on the surfaces of the solid particles has been decomposed into Na_2CO_3 that the change can no longer continue at a sufficient velocity successfully to "oppose the constraint." The change in weight of any of the dissociating systems, or the analysis of the residue, or the microscopic examination of the solid particles in the residue will confirm this statement. If one selects colored crystals, for example $CuCl_2.2H_2O$ (green-blue), which on dissociation yield a solid of another color, for example $CuCl_2$ (brown), then a direct microscopic examination of the residue will show at a glance what has actually occurred in one of these experiments. The brown powder stands out in strong contrast to the underlying green-blue crystals.

The extension of the dynamic method throughout wider ranges of a dissociation-curve is limited only by the experimenter's ingenuity and resources. The experiments described for the first time in this paper along with those referred to in previous papers form a reasonably complete experimental survey of the dynamic method.

CHARACTER OF MOONSHINE LIQUOR.*†

By J. M. Doran and G. F. Beyer.
Industrial Alcohol and Chemical Division, Prohibition Unit, Internal Revenue Bureau, Washington, D. C.

The most casual survey of the public press must impress every one with the vicious if not deadly character of the illicit liquor that is now being dealt in and consumed for beverage purposes. Its effects are noticeable in all sections, and while the drinking of illicit liquors may be more prevalent in the large metropolitan centers than in the rural districts, it nevertheless is sufficiently widespread to become a matter that vitally concerns the public health, even though only a minority may thus indulge itself. It is doutful whether reliable data is at hand to know what percentage of cases of alcoholism treated at hospitals show after-effects or involvements more serious than those noted prior to prohibition. There is ample evidence in the shape of fragmentary reports by the press, heads of hospital staffs, public officials, Federal, State and city, to show that while alcoholism is less prevalent, its attendant and after-effects are more serious.

We may eliminate from the present consideration the seemingly periodic and deadly wood alcohol or methanol drinking epidemics. The results measured in deaths and total blindness are ghastly. That methanol is the cause is at once apparent, but the criminals all too frequently escape. We must assume that the manufacture of illicit liquors with methanol is a matter of ignorance on the part of the compounder, and while he is a lawbreaker at heart, it is inconceivable that he is also a murderer. The same is true even, though it be in a less degree, of the illicit compounder of liquors who uses any one of the denatured alcohols which contain a varying percentage of methanol ranging from 2 to 10 per cent.

Neither is it necessary to dwell at any great length on the illicit beverage use of liquors prepared from rectified or redistilled denatured alcohols of the many authorized formulas, the drinking of tincture of ginger, proprietary remedies or toilet waters. The character of the beverage is known and quite accurate deductions may be made. These abuses are apparently becoming much less as time goes on although directly subsequent to the enactment of the

*Read before the Food and Drugs Section of the American Public Health Association at Cleveland, October, 1922.
†Reprinted from *Amer. Journ. of Public Health.*

National Prohibition Act we undoubtedly passed through an experimental or try-it-once stage.

The laboratories of the Internal Revenue Bureau have examined not less than 75,000 samples of illicitly distilled liquors alone subsequent to prohibition and it is apparent from this large amount of data that the chemist is able to point out some definite oustanding facts based on large numbers of analyses that are worthy of consideration when the question of the effect on the public health of the drinking of the so-called "Pure corn liquor" or straight out "Moonshine" is seriously considered by scientists interested in these matters. In our judgment a most serious problem is presented by the use of the locally and domestically distilled liquors. A large element of the present drinking public alarmed by the recorded and published effects of drinking methanol mixtures is disposed to resort to the liquor of seemingly known and recent origin under the impression that being locally or home made it is at least safe and pure. The results of our many thousands of analyses of this character of liquors shows that this may be a fallacy. The evident stupefying or knockout effects of this liquor in addition to the ethyl alcohol effect point to the same conclusion.

For generations the moonshiner of the mountains even if he were illiterate knew that the heads or first running of the distillation and the tails should be thrown away. He also knew that the middle run must be redistilled several times to make what to him was a passable mountain dew. He was extremely careful of his yeast and guarded it jealously. He did not know that the heads were high in aldehydes or that the tails were high in fusel oil. Neither did he know that redistilling over and over still further eliminated aldehydes and fusel oil, yet he knew by experience that unless he did do these things that even the strong man of the hills could not stand up under the load.

From that old practice there developed the large scientifically controlled grain distillery of pre-prohibition days. Even the distillery product was not considered potable when first made but was aged in wooden barrels for years before being considered fit for sale as beverage liquor.

Crampton and Tolman [1] in an exhaustive series of whiskey analyses covering all ages and characters of whiskey showed conclusively that the fusel oil content of whiskey was not eliminated on ageing but even increased as the concentration of whiskey in the wood increased. It is apparent, therefore, contrary to a somewhat

prevalent idea, that the harmful effects of new whiskey are not due to its fusel oil or higher alcohol content.

Some have held that the ageing process in wood and the gradual change or mellowing of flavor and taste was due to the slow reaction between small quantities of organic acids and higher alcohols with the formation of the highly flavoring and odorous esters. This is probably true but these chemical reactions do not seem to be sufficient to account for the marked difference in physiological effects noted when new or raw whiskey is compared with old.

The chemists of the Internal Revenue Laboratory who have made thousands of analyses of aged in the wood whiskies prior to prohibition, now note that samples which come into the laboratory in connection with raids on moonshine sugar, grain, or fruit distilleries usually show a high content of acetaldehyde. The "ranker" the liquor the higher the aldehyde content. The reason is of course apparent. The impossibility of fermentation control by the moonshiner results in a considerable oxidation of the ethyl alcohol into acetaldehyde and even acetic acid. The simple pot still and the eagerness for more profits in not discarding heads and tails did the rest and the liquor presented to the trustful purchaser had everything that is needed to deliver a complete knockout.

	Alcohol per cent. by Vol.	*Acids**	*Aldehy.**	*Furfur.**	*Fusel Oil**	*Esters**	*Solids**	*Remarks*
1.	46.44	34.8	22.0	None	137.3	52.8	10.4	Trace copper salt, probably the acetate.
2.	43.7	40.8	28.0	None	79.2	44.9	28.4	Zinc salt present, probably the acetate.
3.	48.06	129.6	16.0	None	105.6	42.2	42.6	Zinc salt present, probably the acetate.
4.	47.63	12.0	34.0	0.5	72.2	48.4	7.8	
5.	47.87	34.8	20.0	0.5	117.9	49.3	71.2	Zinc salt present, probably the acetate.
6.	44.54	55.2	24.0	Trace	81.0	43.1	36.0	Zinc salt present, probably the acetate.
7.	46.26	50.4	20.0	0.25	102.1	24.6	15.2	" " " "
8.	41.0	54.0	26.0	None	109.1	79.2	6.8	
9.	43.25	48.0	24.0	Trace	96.8	48.4	14.2	
10.	47.3	61.2	20.0	Trace	91.5	107.4	7.2	
11.	77.0		100.0					
Max.		129.6	100.0	0.5	137.3	107.4		
Min.		12.0	16.0	0.0	72.2	24.6		
Av.		52.08	30.36	0.138	99.27	54.03		

*Parts per 100,000.

A few analyses of typical moonshine or so-called pure corn liquors selected at random are given above. These are merely illus-

trative as hundreds of similar analyses are available. All of the samples were purchases in criminal cases and may be considered as fully representative of their class.

In the article of Crampton and Tolman referred to above the following average maximum and minimum figures are given for new whiskies for comparison purposes to the table given above.

	Acids	*Aldehy.*	*Furfur.*	*Fusel Oil*	*Esters*	*Solids*
Maximum	29.1	15.0	2.0	171.3	53.2	161.0
Minimum	1.2	Trace	Trace	42.0	1.3	5.0
Average	6.4	3.9	0.9	95.2	16.3	20.1

The comparison of these figures given in Crampton and Tolman's paper with the figures for illicit liquors will show the only essential chemical difference to be in the aldehyde content. It should be noted that acid and ester content of whiskies increase with age, therefore, the toxic effects of new whiskey is not attributable to the acid, ester, or fusel oil content. As whiskey ages there is no doubt a polymerization of aldehydes which still further decreases its toxicity.

The presence of copper and zinc salts shown in six of the eleven samples taken as examples is by no means unusual in these illicit liquors. The condenser of the still, or the vessels in which the liquor is handled are the source of these metallic salts. The effects of these salts when taken internally are so well known as to require little comment. Many a case of poisoning or acute gastritis is no doubt due to this factor alone.

The medical and chemical literature contains very little data on the toxicity of acetaldehyde. Albertoni and Pisenti[2] in an article on the physiological properties of acetaldehyde state in part:

> "The experiments were performed on rabbits which were given from 1 to 2 cc. of acetaldehyde, and at other times these same animals were allowed to inhale the fumes of acetaldehyde for several days. The changes that took place were principally in the blood vessels of the various organs. This took the form of arteriosclerosis. Sometimes the tunica intima became somewhat thickened, while the adventitia was nearly always thicker than normal. In some cases, these changes were very apparent, while in others, they were scarcely noticeable.
>
> "In one case, a peculiar growth of the connective tissue of the liver was noticed with consequent infiltration of leucocytes. In this case, the liver had the appearance of incipient cirrhosis, similar to that produced by the continued use of alcohol.

"The changes produced in the mucous membrane of the stomach and kidneys were faint at times, while at other times very pronounced. In some of the kidneys, the Bowman capsules contained a fine fibrous and granular substance. The vascular network of the glomerulus was constantly filled with blood, as was also the rest of the blood vessels of the kidneys."

Holland's Medical Chemistry and Toxicology states "Acetaldehyde is a rapid intoxicant, inducing profound stupor and deleterious after-effects, such as attend the drinking of high wines (raw spirits) which have not been deprived of it as they should be before taking internally."

The U. S. Dispensatory states acetaldehyde possesses marked antiputrescent properties, meat being preserved for months by its 2 per cent. aqueous solution. The intoxication caused by it in animals is characterized by a very great loss of sensibility, rapidity of action and deleterious after-effects. It appears to paralyze the vagi, although its cardiac action is comparatively feeble. Upon the respiration it exerts a powerful influence: in small doses quickening it, in large doses depressing it. The temperature is much diminished.

It would be extremely interesting and instructive if a thorough study could be made of the action of the various aldehydes in varying percentages in alcoholic solution as more light could then be thrown on a question which at present rests to some extent on speculation. It is hoped that this problem may be pursued further in the chemical and biological laboratories.

One statement may be made definitely however and that is that the harmful constituent or constituents of new whiskey if they be aldehydes is and can only be removed in one of two ways. Either by fractionating in an alcohol column or long ageing in a wooden barrel. Neither of these ways appear to be open or available to the present day moonshiner.

Public enlightenment on these matters is necessary. The work of the chemist is rendered ineffective unless other professions interested in public health matters lend their efforts towards bringing a fuller knowledge of these basic scientific facts before all. The public is entitled to know these things in order that it may act with intelligence in its own protection.

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1. *Jour. Amer. Chem. Soc.*, Vol. XXX, 1908.
2. *Centr. f. d. Med. Wissensch.*, 1888, XXVI, 401.

AMERICAN CONTEMPORARIES.*

JOHN URI LLOYD.

To know a man you must see him at his work. To do this in the case of John Uri Lloyd you amble down a quiet side street in Cincinnati and find the pharmaceutical manufacturing concern of Lloyd Brothers—three of them, one of whom seems to watch over the more impractical two, a second who is constantly at molds and never at business, and the third who is the subject of this sketch. To find him, you enter the business office where fast work is necessary if advance is to be made. Better an appointment ahead or else some twenty voices are likely to carry the information that the "Professor," as he is right, appreciatively, and affectionately called, is off the premises with no prospect in the visitor's life of return. And when a man's soul is in the spirit world is this not the truth? But if you can give the right sign—and an ability to discuss mass action is a better one than salesmanship—a friendly hand from a brother, a secretary, or a production manager urges you through a door. You choose between walking up four flights or taking the freight elevator. Again you feel lost until "Edee," who is at once cheerful presence, technical assistant, and guardian lion to the Professor, guides you with gentle voice through dark corridors into one of two or three cubicles, immaculately clean, spotlessly in order, and strictly at work. And here, either from his desk or from over some beakers the Doctor of Science, *honoris causa,* or the "Empiricist and Irregular," as he calls himself, welcomes you.

I do not remember a time when, either alone or with a group of scientific friends, there was not in his first words a note of appreciation for *their* endeavors—a proof at once of his first-hand knowledge of the other man's life and the catholicity of his thought, for politicians, practical men, and theorists who put the modern builders of the atom to shame, all seek him out. Such greeting is followed by, "May I tell you a story?" And then some pearl, fitting well into the setting of the moment, is brought forth from his seventy-odd years of oyster life which even the great must pass through. In the pause which follows he speaks again: "I have prepared an experiment which I should like to show you." In those who have had this

*Reprinted from *Jour. Industr. and Eng. Chemistry.*

experience several times, a warm rush of blood to the head is the emotional response which foretells that now some new decoration will be knocked off their scientific gargoyle. Do you hold the Guldberg-Waage law all sufficient; is the "dew" on plants a settled question for you; do you think that the tincture preparer of 1850 knew everything; is your view of solubility a crooked one because you know only water; is water itself just H_2O to you; is biology and undertaking confused in your mind; are you sure that you know where the alkaloids come from; do you know why plants are green, or sometimes red, or maybe black; or why flowers are white and sometimes yellow? Answer carefully if your philosophy, your faith, or your religion are built up on the demonstrable in nature and not upon the interpolated texts of our scientific cook-book makers.

As you wait for a solution to filter, your eyes wander into the background. What are those vials labeled *a* to *d?* "Just alkaloids separated from ———." And what are those labeled I to IX? "Another set from ———." But you were sure that each of these infernal plants contained but one alkaloid. Quite so, but here are the rest. And knowing that fat reputations have been built upon the discovery of just one alkaloid, you ask when the Professor will publish his results. "I am not young any more and a bit tired. Let me tell you about them and then you publish the facts." You see on the table a pot of tar-like material. And what is that? "Just the muck which you 'regulars' think it well to carry along with the bits of active material in your standard pharmaceuticals and which, after twenty years of work, I have learned to get out by my studies of differential solubility." You feel that you have heard just an overtone of bitterness in his voice, but a look at his face seems to belie your impression.

You digress from the material of the demonstration to its philosophic consequences, and philosophic consequences join quite naturally to the business of life itself. Is science a cloak to you which may be put on and off during convenient working hours? If so, John Uri Lloyd does not interest you for to him it is life itself. Do you find her a yoke gladly to be cast aside were the rewards of labor not so necessary? Again our man does not interest you for he follows her as lovers, romance; and children, the rainbow. Alkaloids are not things to be made into medicine, but voices which speak from another world. To be a practical man of chemistry is simply

to ease the material life of a fellow that he may enjoy better the fruits of the spirit.

You rise to go. You find your way out as you came in, but you are not conscious as you were of the externals. You are more conscious of the internals. You have lost something—some of your scientific prejudices, some of your party adherences, some of your reverences for mere tradition. Also you have gained something—a more mobile state of mind, a larger tolerance, an increased generosity. And you are conscious that this is because for a little while you have been away from commissions, committees and boards, from diagrams, formulas, and fudge, and from canned efficiency, officialism, and Main Street, and for the same length of time have lived in the presence of the one thing that moves our universe, an individual and a man who is as good a picture in flesh and blood of what science stands for as may be found in the day's journey.

MARTIN H. FISCHER.

SCIENTIFIC AND TECHNICAL ABSTRACTS

ESSENTIAL OIL OF EUCALYPTUS CNEORIFOLIA DC.—The genus *Eucalyptus* (Myrtaceæ) is a prominent feature of Australian flora. Many species have been described, some of them trees of great height. A detailed study of oil of *E. cneorifolia* DC, made by Philip A. Berry, B. Sc., appears in the Trans. & Proc. of the Royal Society of South Australia (1922, xlvi, 207). Considerable difference exists between the oil yielded by the leaves and stems in January (summer) and May (late fall). The January distillate gave Berry the following results, the yield being 1 per cent.:

Color		orange brown
Sp. gr. 15°/15° C		0.9102
Sp. rot. (20°)	a(D)	—10.4
Ref. ind. (20°)		1.4707
Dispersion (C-F)		0.1029

Soluble in 1.33 vols. of 70% alcohol.

The proximate composition is:

	Per Cent.
Cineol	67
Cymene	15
Limonene	5
Pinene	3
Aldehydes (cumic, cneoral, aromadendral, cryptal)	7.5
Phenols, esters, acids	0.5

H. L.

PLATINUM CONDITIONS IN 1922.—Advance sheets of the 1922 issue of the "Mineral Resources of the United States," have just been distributed by the Geological Survey. The section devoted to platinum and allied metals was prepared by J. M. Hill. The enormous advance in the price of platinum has been a serious burden upon some industries and upon chemists. The metal is practically indispensable in a few analytic operations, though fused quartz and some alloys have partly relieved the strain. For many years, manufactured platinum ware sold at retail at about 3 cents a grain. Crude metal in ingots was sometimes as low as $9 per troy ounce. The principal supply was from the Urals, only small amounts coming from other sources, some South American gold occasionally yielding a little. The price began to advance about the beginning of the present century, and with slight fluctuations has steadily increased until platinum wire was lately quoted by a supply house at $3.97 per gram, close to $125 per troy ounce, about six times the price of gold. As soon as the price advanced materially above that of gold, jewelers began to use it, and the consumption for this purpose has contributed largely to the present exalted figure. Nearly 70 per cent. of the platinum used in the United States enters into jewelry.

The report gives no encouragement to those who are hoping for a material reduction in cost of the metal. Notwithstanding the intensive search, stimulated by the high price, no new localities of importance have been found. A promotor's boom was started in one of the western States, but soon collapsed under expert examination. The Russian field has not yet resumed active supply. In 1913, 250,000 troy ounces were furnished by it. The yield fell to one-half in 1915, and steadily decreased, until in 1921 only 20,000 ounces

are credited. Colombia is now the most abundant producer, nearly 40,000 ounces having been imported into the United States in 1922. This is, of course, crude, carrying more or less of the related metals. The production in the United States is inconsiderable; only about 1000 ounces in 1922. A notable item is the use of palladium in jewelry for the manufacture of the so-called "white gold." The price of this metal has remained during the year at about $55 per troy ounce. Iridium has risen greatly, closing for the year at $260 per troy ounce. The customs reports for the year show no direct Russian supply, but considerable importations from Esthonia, Latvia and Sweden are believed to be of Russian origin. About 35,000 ounces credited to England and 11,400 to France are, of course, obtained from other countries, probably principally from Colombia and Russia. No definite information, however, seems to be at hand as to the extent to which the Russian fields were worked during the period covered by the report.

The relative amounts of platinum and allied metals used in certain industries are approximately as follows:

	Per Cent.
Jewelry	66.6
Electric apparatus	16.1
Dental materials	9.5
Chemical apparatus	5.2

The balance is distributed through several minor industries. The most marked increase over 1921 is in jewelry, which rose from 59.5 per cent. to the figure given above. H. L.

VICHY SALT AND SODIUM BICARBONATE.—From an article in a recent issue of the *Schweizerische Apotheker-Zeitung*, it is learned that for many years commercial sodium acid carbonate has been sold in France as "Vichy salt," the title being officially recognized by both Codex and public authorities. Similarly, the Codex terms magnesium sulphate, Seidlitz salt. The editor of the journal regards these titles as contravening the laws against misbranding. Regard for the antiquity of the custom seems to be basis of the unwillingness of those in control to change. In 1818, the Codex used both Epsom salt and Seidlitz salt for magnesium sulphate, but in 1908 dropped Epsom salt from the synonym list. The company operating

the Vichy springs has petitioned the government to drop from the official list the title "Vichy salt" for bicarbonate. The proposition has been submitted to the Academy of Medicine by the Minister of Public Instruction. The story of the affair is given as follows:

About 1826, d'Arcet published a formula for the preparation of pastilles for indigestion consisting of sodium acid carbonate, and established at Vichy a factory for utilizing carbon dioxide obtained from the spring known as "Grand Grille," with sodium carbonate from the Leblanc process. From this originated the Codex title. In 1904 the company operating some of the springs in the Vichy basin, installed a plant for evaporating the waters, and asked that the title in the Codex be cancelled. The authorities having charge of the edition of 1908 did not accede to the request, and it was renewed in 1919 and 1922. The existing committee declines to grant the request on the ground that the title has been very long in use and such use does not seem likely to imperil the health of the people. The committee also asserted that there is no definite "Vichy salt" obtained from Vichy waters, inasmuch as the composition of the residues from evaporations differ materially according to the sources, and added further that the interests of the operating company are fully protected by the titles "Natural Vichy salts" and "Pastilles" from the same.

The question, however (argues the editor of the *S. A.-Z.*), has another phase. Is it not unwise in principle to use terms closely alike to designate different articles? The position taken by the Academy of Medicine in refusing to recommend the abolition of the term Vichy salt for sodium acid carbonate is that there is no real Vichy salt of definite composition derived from the Vichy springs, and that the trade-mark "Vichy salts" protects the company. It will be impossible to determine, therefore, what ingredient of the residue should bear the title (in the singular) of "Vichy salt." It seems, therefore, that in France sodium bicarbonate will continue to be sold as Vichy salt.

In this connection mention may be made of an expression of opnion concerning the way in which mistakes between barium sulphate and barium sulphide may be prevented. A correspondent of *S. A.-Z.* suggests that the chemical formula should be written after each name on every prescription. It is doubtful if this will meet general approval among doctors, who hate chemical formulas and are often sadly in error concerning them.

H. L.

SOLID EXTRACTS

A simple remedy for mushroom poisoning has been announced by Dr. Schwitzer of Cassel. It consists in eating a quantity of animal charcoal which is said to have the property of absorbing the poison, and then eliminating the charcoal from the system before the poison has opportunity to be reabsorbed.

Animal charcoal has the power of absorbing colors and other substances and was generally used in the war in gas masks as the absorbent for deadly gases. Dr. Schwitzer announces that as the result of experiments he has found it absorbs the deadly alkaloids present in the poisonous mushrooms, popularly known as "toadstools," and renders them harmless.

Albino rats and albino people are more or less familiar to everybody. Out in the Missouri Botanical Garden, however, there was recently an albino California redwood tree. It was grown in a bowl from a piece of redwood bark. Shoots and leaves springing from this bark were perfectly white. Roots did not develop and the shoots died, but the mystery is not yet solved as to why the green color pigment of the normal redwood was lacking.

A story recently appearing in a fiction magazine, tells how a murderer's identity as an Australian was established by the ability of a physiologic chemist, by means of a serologic test to prove that certain stains upon the handle of the murder weapon were kangaroo blood, and the blade stains were human or the victim's blood.

How dandelions, plantains, dock, and other broad-leaved plants have been completely banished from lawns in experiments with a new chemical spray was told at a recent meeting of the American Chemical Society. Good control over bitter rot, apple scab and other fungous diseases was also indicated.

The lawn weeds were eradicated with but slight injury to blue grass and clover, but the control of the plant diseases was accompanied by considerable injury to the foliage. Selenium was used instead of the sulfur, commonly employed in such poison solutions. The most successful of these selenium sprays was found to be selenious acid and sodium selenite.

Insufficient sleep causes impairment of memory according to recent researches on the subject of sleep. The memory becomes unreliable even if the shortage of sleep has occurred for only a short time. Eight hours is the average needed for sleep, but brain workers sometimes require more. A reduced period of slumber may be partly made up for by increased intensity, a short period of deep, undisturbed sleep having the same effect as a longer and lighter one.

We may also derive some comfort from the psychologist's discovery that brain workers need a month of rest every year, and that even longer va-

cations do not cause a lessening of acquired abilities, but rather an intensification of them.

The vitamin values for cow's milk and butter are known to be higher during grass feeding in summer than during winter feeding on roots, hay, and "concentrates." Along comes a scientist now, with the information that by giving the cows cod-liver oil as a supplement to a diet of hay, roots, and cake mixture, increased nutritive value of the butter may be obtained.

Honeybees turn on the heat in their apartment houses at 57 degrees Fahrenheit. When it gets that cold, they form a compact spherical cluster. Bees on the inside of the ball become active and walk, wiggle, and beat their wings to generate heat. The outer shell of the cluster is made up of bees that cuddle close and stay still. They furnish the insulation which prevents the escape of heat so effectively that there may be 75 degrees difference between the inside and the outside only 4½ inches away. Thousands of dollars are lost to American bee-keepers every year, however, by bees working themselves to death in keeping warm this way.

Germs can now be dissected and handled under the microscope according to a report sent to the American Medical Association by its Budapest correspondent. Dr. Tibor Peterfi of that city has demonstrated to a medical society a device with which an investigator can grasp bacilli and cut them with glass and platinum needles. This is expected to result in new physical and chemical investigations.

Tops of submarine volcanoes rising from extreme deeps in the lonely Pacific are now furnishing fertilizer for farms in Great Britain. Nauru and Ocean Islands, 165 miles apart and 2000 miles northeast of Australia, are being actively worked for phosphate. Each island is encircled by a coral reef on which is built a long steel traveling crane. The cranes carry the phosphate from the island shores across the reefs and discharge it into steamers anchored in the ocean outside.

Can you imagine a blossom as large as a carriage wheel? On the Island of Mindanao, one of the Philippine Group, such a flower was found by some explorers some years ago. Far up on the mountain of Parag, 2500 feet above sea level, some explorers were wandering when they came across some buds larger than gigantic cabbage heads. Greatly astonished, they searched farther and presently discovered a full grown blossom five petaled, and three feet in diameter. It was carried on low-lying luxuriant vines. The natives call it "Bolo." They found a single flower to weigh twenty-two pounds. It was afterwards discovered to be a species of Rafflesia, first found in Sumatra, named after Sir Stamford Raffles. The new flower was called "Rafflesia Schadenbergii," in honor of its discoverer.

The flower is very thick, the petals being three-quarters of an inch in thickness. Its striking beauty is

spoiled by its intolerable odor which pollutes the air for many feet around it. It is a parasite, growing on low trailing vines, which are found in great abundance in tropical forests.

One of the dazzling foundations of the city of the New Jerusalem as revealed to Saint John on the Isle of Patmos was made of compound of the element, zirconium. Another compound of the same element may be used to light the bungalows of the future. As jacinth, zirconium was prized by oriental potentates as a gem. In its metallic form it may be employed by Americans to read newspapers on winter evenings, for its properties favor its use as a substitute for tungsten in incandescent electric light filaments. Before that is done, however, the chemist will have to learn how to remove the impurities from the metal more readily.

Most of us know that Tabby, the house cat, likes catnip. It remained for Government scientists, however, to apply this knowledge practically to the big cats. They found the hunting of mountain-lions and bobcats with dogs and guns to prevent destruction of western cattle was an expensive proposition. Then they thought of catnip. Large quantities of this aromatic herb were raised. From this, chemists extracted the volatile oil, which gives it its odor. Now it is no longer necessary to look up the lions, they walk right into traps scented with catnip oil.

After smoking a cigar or three cigarettes, blood pressure rises and the heart beats faster. This is the finding of Dr. Robert L. Bates, psychologist at Johns Hopkins University, who carried on experiments so that physicians could have real evidence on the dangers of smoking during sickness.

The rise in blood pressure and heart rate is only as much as might occur normally due to other conditions, and both return to normal in from twenty to thirty minutes. Dr. Bates was unable to determine how much of the change was due to the products of smoking tobacco and how much to mental effects, for it is known that emotions and mental processes may also affect pressure and heart rate.

NEWS ITEMS AND PERSONAL NOTES

Notice of College Meetings.—Hereafter notices of stated and special meetings of the members of the Philadelphia College of Pharmacy and Science will appear on the front cover page of the American Journal of Pharmacy. No additional notice of the meetings will be sent by mail as formerly. Members are therefore requested to keep this in mind and to make note of the respective dates as announcements are made.

Louis L. Staehle, Treasurer of the New Jersey College of Pharmacy, Deceased.—Louis L. Staehle, one of the founders of the New Jersey College of Pharmacy and for many years its Treasurer, died at his home in the Tuxedo Park section of South Orange on the evening of November 14th. Mr. Staehle was born in Short Hills, New Jersey, November 19, 1858, and was the son of Louis L. Staehle and Mary Traumiller. He came to Newark with his parents at the age of 10, and was graduated from the New York College of Pharmacy in 1876. His first position was with Dr. Fridolin Ill, in Newark. Three years later he entered the drug business and at one time had three stores. At the time of his death he was still in business at 169 South Orange Avenue.

League of Nations Physicians Inspect Mulford Laboratories.—A group of physicians of the Medical Section of the League of Nations, visiting Philadelphia and vicinity during the weeks of November 12th-24th, were entertained by the H. K. Mulford Company on Thursday, November 15th. After inspecting the Pharmaceutical Laboratories in the morning, the party was given a luncheon at the Art Club. The afternoon was spent at the Mulford Biological Laboratories at Glenolden, Pa., where the processes carried out in a modern, large-scale biological laboratory were explained to them in detail.

The interests of the visitors being centered in medical research and public health problems, they were especially impressed with the preparation and testing of Pneumococcus Antibody Solution, a new specific for pneumonia developed as the result of research work carried out in these laboratories by Dr. F. M. Huntoon, Chief Bacteriologist and Medical Director of the Mulford Laboratories, and formerly Professor of Bacteriology at Cornell University.

The visiting delegation included: Dr. Vasconcellos, Brazil; Dr. Segovia, Director Sanidad, San Salvador; Dr. Carnwath, Ministry of Health, London; Dr. Russieri, France; Dr. Pringos, Director of State Bacteriologic Laboratories, Athens, Greence; M. Voeihoff, Sanitary Engineer, Moscow, Russia.

Armistice Day Celebration at the Philadelphia College of Pharmacy and Science.—On Tuesday, November 13th, the members of the Senior Class of the Philadelphia College of Pharmacy and Science, which includes upward of one hundred ex-service men, celebrated Armistice Day during the early morning period.

The Senior College orchestra furnished excellent music, patriotic and popular songs were sung by the entire class, and addresses were made by Dr. William C. Braisted, Surgeon General of the United States Navy, Retired, and by John Derwin, Esq., Chairman of the Speakers' Committee of the Philadelphia County organization of the American Legion.

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American Journal of Pharmacy

ESTABLISHED IN 1825

Four preliminary numbers were published at different times until in 1829, when the publication of the regular volumes began. Since then the publication has been uninterrupted. During the period from 1829 to 1852 four numbers were published annually, except in 1847, when five numbers were published. From 1853 to 1870 six numbers were published. Since this time twelve numbers have been published annually.

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Drugs:
H. K. Mulford Co.

Druggists' Sundries:
Valentine H. Smith & Co., Inc.

Embossing & Cutting Dies:
Photo-Chromotype Engraving Co.

Endocrine Gland Preparations:
Armour and Company

Essential Oils:
Fritzsche Bros. (Obtainable from your jobber)

Flavors:
The Wm. S. Merrell Co.
("Merco" Brand, Non-alcoholic)

Henbane Leaves:
A. M. Todd Co.

Herbs—Pressed and not Pressed, in Cartons:
Parke, Davis & Co.

Hypodermic Supplies:
Sharp & Dohme ("The Hypodermic Tablet People")

Infants' & Invalids' Food:
Fairchild Bros. & Foster